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SATELLITE PROVIDED CUSTOMER PREMISES SERVICES: A FORECAST OF POTENTIAL DOMESTIC DEMAND THROUGH THE YEAR 2000

FINAL REPORT - VOLUME III - APPENDICES

BY D. KRATOCHVIL, J. BOWYER, C. BHUSHAN, K. STEINNAGEL, D. KAUSHAL, G. AL-KINANI

THE WESTERN UNION TELEGRAPH COMPANY
GOVERNMENT SYSTEMS DIVISION
MCLEAN, VIRGINIA 22102

PREPARED FOR:
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16. Abstract

The overall purpose of this study was to forecast the potential United States domestic telecommunications demand for satellite provided customer premises voice, data and video services through the year 2000, so that this information on service demand would be available to aid in NASA program planning.

To accomplish this overall purpose the following objectives were achieved:

a. Development of a forecast of the total domestic telecommunications demand

b. Identification of that portion of the telecommunications demand suitable for transmission by satellite systems

c. Identification of that portion of the satellite market addressable by CPS systems

d. Identification of that portion of the satellite market addressable by Ka-band CPS system.

e. Postulation of a Ka-band CPS network on a nationwide and local level.

The approach employed included the use of a variety of forecasting models, a parametric cost model, a market distribution model and a network optimization model. Forecasts were developed for: 1980, 1990, and 2000; voice, data and video services; terrestrial and satellite delivery modes; and C, Ku and Ka-bands.

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NASA STUDY

TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

NASA STUDY
TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

NASA STUDY

TABLE OF CONTENTS

APPENDIX A
BASELINE FORECAST

A.1 INTRODUCTION

The baseline forecast is a projection of the current and future volume of traffic. Every service must be examined with regard to its own unique past and future, taking into consideration only those events with a high probability of occurrence.

A number of factors were taken into consideration in determining the baseline forecast:

a. The difficulty in determining both the current traffic volume and future traffic volume for 1990 and 2000

b. Defining the services so that all traffic in the United States is included, but none counted twice

c. Predicting traffic volume is further compounded by machines operating at various speeds and using different transmission media, such as digital and analog.

Given these factors the following approach was used to derive a baseline forecast for each of the thirty-one services for 1980, 1990 and 2000.

The first step in determining the baseline forecast was to clearly define each of the services. A review of the current literature and discussions with various vendors provided information for refining service descriptions and characteristics. These same sources were used to make future projections and thus understand the changing and developing service definitions. In order to remain consistent, our definitions were compared and altered to be as compatible as possible with those used in an earlier (1) study. A summary of the changes made since this earlier study are indicated in Table A-1 and the names of the 34 services considered in this study are listed in Table A-2; it should be pointed out that forecasts were developed for only 31 of these 34 services.

Once the services were defined, it was necessary to determine the method to be used to derive the baseline. Basically, this step consisted of gathering available

TABLE A-1.

SUMMARY OF CHANGES MADE IN THE NAMES OF THE SERVICES

	These Services	Called Them
Combined:	Data Transmission (Part) Data Entry	Data Entry
	Data Transmission (Part) Electronic Funds Transfer Inquiry/Response	Inquiry/Response
	Private Timesharing Commercial Timesharing	Timesharing
	Operational Facsimile Convenience Facsimile Special Purpose Facsimile	Facsimile
Deleted		
	Packet Switching	
Added		
	Direct Broadcast Satellites High Definition Television Voice Store-and-Forward Video Recording Channel Point of Sale	
Split-Radio		
	Public Radio Commercial and Religious Radio Occasional Radio CATV Music Recording Channel	

TABLE A-2. NAMES OF SERVICES CONSIDERED IN THIS STUDY

	GROUPING	SERVICE
VOICE	Message Toll Service	Residential Business
	Other Telephone	Private Line Mobile Radio *Voice Store-and-Forward
	Radio	Public Commercial and Religious Occasional CATV Music Recording Channel
DATA	Terminal Operations	Data Transfer Batch Processing Data Entry Remote Job Entry Inquiry Response Timesharing
	Electronic Mail	USPS EMSS Mailbox Services Administrative Message Traffic Facsimile Communicating Word Processors
	Record Services	TWX/Telex Mailgram/Telegram/Money Order
	Other Terminal Services	Point of Sale Videotex/Teletext Telemonitoring Secure Voice
VIDEO	Broadcast	Network Video CATV Video Occasional Video Recording Channel
	Limited Broadcast	Teleconferencing *DBS *HDTV

*Forecasts were not developed for these services which were treated as market determinant factors.

information from user surveys, industry analyses, magazines, and internal sources for each service. Other studies, including the two original trunking studies, (1,2) also were reviewed to determine how others projected traffic demand. Using this information, the basic approach and necessary steps to determine a baseline for each service was determined. This approach was based largely on: historical information (such as telephone traffic); future volume of the machines producing the traffic (such as computer terminals for data traffic); or on the future volume of the actual service (such as electronic mail). The most appropriate basis was selected for developing the baseline for each service. In some instances, this differed from the approach taken in the first study. For instance, in this study television traffic was projected for actual satellite usage; previously, the amount of traffic throughout the U.S. was determined.

Once the technique for forecasting the baseline was determined for each service, a detailed analysis was conducted. Vendors and users were contacted, the most recent industry studies were obtained, and government agencies were visited. The particular steps used to determine the forecast are given under the discussion of baseline for that service. After deriving the baseline, it was discussed with Western Union Product Line Managers, Engineers, and Market Researchers; their feedback was used to fine tune the projections.

As indicated in Table A-2, besides the thirty-one basic services, three other services were considered: voice store-and-forward, Direct Broadcast Satellites (DBS) and High Definition Television (HDTV). Voice store-and-forward is not actually a new service, but rather a way of aiding the business message telephone service. Therefore it was treated as a market determinant factor, and its effect shows up in the impacted baseline. DBS and HDTV are unique services and were discussed together. A forecast of these services was not made, however, since the 1983 World Administrative Radio Conference (WARC) and the FCC are very likely to allocate a separate area of spectrum outside the C-, Ku- or Ka-bands normally used. It is likely that these services will have an impact on other video services, therefore, they were treated as market determinant factors.

A.2 VOICE APPLICATIONS

The most widely used services fall within the voice categories. There are several reasons for this. First, almost everyone and every business has a telephone. Second, there are no standardization problems as there are with data or video, so it is easy to use. Third, it requires very little bandwidth to transmit a high quality signal, so it is a relatively cheap way to communicate.

Voice applications are grouped, as follows, into three sections: message toll service, telephone and radio.

Message Toll Service	Residential Business
Other Telephone	Private Line Mobile Radio Voice Store-and-Forward
Radio	Public Commercial and Religious Occasional CATV Music Recording Channel

The message toll service and telephone sections deal with all regular telephone conversations. Much of the information used in these projections came from AT&T tariff filings as well as historical information filed by all the independent phone companies. Mobile Radio, which is commonly thought of as a car telephone, is undergoing drastic changes as the FCC permits use of cellular radio. The information used to project mobile radio traffic came from FCC filings and internal company studies.

Radio traffic is made up of AM, FM, and a few other subservices; the current trend is toward networks and national programming. The information to project current and future traffic is based on FCC filings and actual plans for use of transponders.

Traffic units for voice are stated in half-voice circuits. This unit is one half of a telephone conversation. For the sake of consistency, radio traffic is also stated in half-voice circuits.

A.2.1 Message Toll Service

Message Toll Service (MTS) is basically a metered switched service used by both residential and business sectors. Residential MTS includes both typical household and coin operated categories of metered switched service as provided by the Bell system and other independent telephone operating companies. Business MTS includes regular business service and Wide Area Telephone Service (WATS).

Metered switched service works by monitoring the time two parties are on the line and charging the call to the calling party. WATS is a long distance dial-up service offered by AT&T Long Lines and other Bell Operating Companies to and from specified zones. Five zones of coverage are provided at various tariffs.

There are two types of WATS service: 800 service (in-WATS) and out-WATS. 800 service is an inbound service, permitting the user to be called at no charge to the calling party. The receiving party subscribes to the service. With out-WATS, the call originator is connected to the WATS line and may call any subscriber within the specified zones.

A.2.1.1 Baseline

The baseline for message telephone traffic is determined by using extensive FCC statistics along with studies completed by AT&T. The basic approach (see Table A-3) starts with the number of toll messages handled in the United States during 1980: 21,832 million. This statistic is available from the FCC form 81-1, "Quarterly Operating Data of 68 Telephone Carriers."[3] To this, a ratio of business to residential calls was determined (55:45) "Bell System Operating Companies: Summary of Reports" (Form D-618) which provided the average number of calls per business and residential phone. After splitting the traffic, the business and residential traffic is divided by the number of days they are used. The peaking factor, as determined by AT&T, is then applied (see Reference 9). The next step is to ascertain the amount of inter and intrastate

TABLE A-3
BUSINESS/RESIDENTIAL MTS 1980

	Business		Residential	
Number of toll messages: 21,832M				
Split		55%		45%
Toll messages		12,007.5M		9,824.3M
Percent of messages occurring between Sunday midnight and Friday midnight		98%		67%
Messages during normal work week (entire year)		11,767.4M		6,582.3M
Work days per year		250		250
Messages per work day		47.070M		26.329M
Percent during peak hour		14.9%		10.7%
Messages during peak hour		7.013M		2.817M
Interstate/intrastate split	60%	40%	40%	60%
Calls	4.208M	2.805M	1.127M	1.690M
Call-minutes/hour	.123	.085	.123	.085
Erlangs	.518M	.2384M	.1386M	.1437M
Half-voice circuits	1.0352M	.4769M	.2772M	.2873M
Half-voice circuits		1.521M		.5645M
Half-voice circuits needed for .9999 service availability		1.588M		.5930M

traffic. Again, the FCC's "Statistics of Common Carriers" provided revenue data. By doing some internal analysis using tariffs, a percentage for each type of traffic (60:40 for business; 40:60 for residential) was determined. The average holding time determined for each type of traffic as shown in an AT&T report "Holding Times", is then applied. To the holding time a factor is added for transmission overhead, obtained from a Bell System Technical Report[4]. Once the traffic was in Erlangs an estimate of the number of trunks (half-voice circuits) needed to provide a .9999 service availability was established. This involved separating the traffic into its different city pairs. Since this was impractical an estimate of the overall percent of trunks was made based on Erlang tables (5 percent was used).

Historical FCC data, along with internal information, was used to arrive at the following projected growth rates for business and residential toll messages (see Reference 10).

MESSAGE GROWTH RATES (%)	1980 to 1990	1990 to 2000
Business	10	8
Residential	8	7.5

No data was available to indicate a change in peaking factors or percent of interstate versus intrastate traffic. Holding times seem to be increasing slightly. Progress is being made on reducing overhead per call; therefore, the holding time plus the overhead was held constant. Based on these projections, it was possible to project the number of half-voice circuits required in 1990 and 2000 for message toll service (see Tables A-4 and A-5). A summary of the 1980, 1990 and 2000 forecast is presented in Table A-6.

A.2.2 Other Telephone

Three other services are telephone related and are therefore grouped. They are: private line, which is the leasing of a circuit; mobile radio, which is a car telephone; and voice store and forward, which is similar to a mailbox for telephone calls.

TABLE A-4
BUSINESS MTS

	1990		2000	
Messages per year		31,144.4M		67238.4M
Percent between Sunday midnight and Friday midnight		98%		98%
Messages during work week (entire year)		30521.5M		65893.6M
Work days per year		250		250
Messages per work day		122.1M		263.6M
Percent during peak hour		14.9%		14.9%
Messages during peak hour		18.19M		39.27M
Interstate/intrastate split	60%	40%	60%	40%
Calls	10.914M	7.276M	23.562M	15.709M
Call-minutes/hour	.123	.085	.123	.085
Erlangs	1.342M	.618M	2.898M	1.335M
Half-voice circuits	2.685M	1.237M	5.796M	2.681M
Half-voice circuits		3.922M		8.467M
Half-voice circuits needed for .9999 service availability		4.118M		8.890M

TABLE A-5
RESIDENTIAL MTS

	1990		2000	
Messages		21209.9M		43174.3M
Percent of messages occurring between Sunday midnight and Friday midnight		67%		67%
Messages during work week (entire year)		14210.6M		29288.6M
Work days per year		250		250
Messages per work day		56.8M		117.15M
Percent during peak hour		10.7%		10.7%
Messages during peak hour		6.08M		12.54M
Interstate/intrastate split	40%	60%	40%	60%
Calls	2.43M	3.65M	5.02M	7.52M
Call-minutes/hour	.123	.085	.123	.085
Erlangs	.299M	.310M	.617M	.639M
Half-voice circuits	.598M	.620M	1.234M	1.279M
Half-voice circuits		1.218M		2.513M
Half-voice circuits needed for .9999 service availability		1.279M		2.639M

TABLE A-6

MESSAGE TOLL SERVICE TRAFFIC FORECAST—HALF-VOICE CIRCUITS

(thousands)

SERVICE	YEAR 1980	YEAR 1990	YEAR 2000
Business MTS	1588	4118	8890
Residential MTS	593	1279	2639

A.2.2.1 Private Line

Private lines are dedicated transmission lines connecting two points. They are leased through AT&T and other telephone companies on a monthly or yearly basis. In the last few years, the FCC has allowed others to enter this market. These companies often discount the most heavily used routes, capturing a larger share of the market each year.

A.2.2.1.1 Baseline

Since private lines are leased full time, there is little need to determine the amount of traffic carried by them as has been done for other services. Instead, the important factor is the number of lines leased.

To determine the number of lines leased (see Table A-7) the revenue for toll private lines from the "FCC's Quarterly Operating Data of 68 Telephone Carriers" (3) was used. This number includes private line revenue from sources other than telephone useage. Based on internal discussions it was concluded that 70 percent of the revenue was from private line telephone. To this an estimate of the additional market held by companies other than the 68 telephone carriers was added. According the consultant studies this currently stands at 15 percent and is growing. Because of the tariffs used (1980) the figures in this report were adjusted.

After determining the revenue, it was split between interstate and intrastate (see Table A-7). This was done using the tariffs and Western Union's own experience. The split was determined to be 72% interstate and 28% intrastate.

The next step was to use an average tariff for both interstate and intrastate to determine the average number of circuits leased during the year. For this FCC Form 260 was used. The charge for a 100-mile interstate line, including station terminal equipment, was determined to be $8,500 per circuit per year. For intrastate, an average tariff for 1,000 miles including station terminal equipment was determined to be $15,000 per circuit per year.

TABLE A-7

PRIVATE LINE
(thousands)

Revenue	$ 3,874,545
Percent contributed to telephone	70
Revenue (Telephone Companies)	2,712,181
15% Revenue (Other Carriers)	426,827
	$ 3,139,008

	INTERSTATE	INTRASTATE
Percent	72	28
Revenue	2,260,085	878,922
Tariff Rates		
Average number of miles	1.0	.1
Rate	12.3	4.5
Circuits in 1981	183.7	195.3
Circuits in 1980	156.2	166.0

Reviewing the rapid increase in competition to provide MTS service and the changes in tariff rates, it was expected that the growth rate for private line service will be around 15% during much of the 1980s [5] gradually falling off at the end of the decade to an average of 10% in the 1990s. A summary of the interstate and intrastate private line forecasts are presented in Table A-8.

A.2.2.2 Mobile Radio

Mobile radio telephone is a service connecting the public switched telephone network to mobile units. Bell Telephone operating companies and other radio common carriers provide the service. Conventional mobile radio telephone uses a single high powered transmitter to cover a service area. Because the signal level of each channel in the area is high enough to cause interference, each channel can only support one conversation within a given service area.

The application of cellular technology, however, will alleviate this congestion, which has suppressed growth in the mobile radio market. In cellular systems, the service area is divided into smaller regions (cells) served by several low power transmitter/receiver sites. Radio channels used in one cell can be reused in another cell a short distance away. Consequently, a given channel can be used simultaneously for many conversations in a single service area. In experiments conducted in Chicago and in the Baltimore/Washington Area, users of cellular radio have been found to use the service three to four times longer than conventional mobile telephone customers. Users have found they don't have to wait to place calls and the quality has been termed "far better" than the conventional system.

Progress in the mobile telephone market had been slowed due to the indecision of the FCC in adopting standards. However, with the recent experiments already mentioned and the setting of 900 MHz as the frequency for cellular phones, the mobile telephone market is just warming up. A possible scenario for nationwide coverage is a conventional cellular system in urban areas augmented by satellite service in rural areas.

TABLE A-8
FORECASTS OF INTERSTATE AND INTRASTATE PRIVATE LINE TRAFFIC
(THOUSANDS OF HALF-VOICE CIRCUITS)

SERVICE	YEAR 1980	1990	2000
Interstate	312.4	1263.8	3278.0
Intrastate	332.0	1343.1	3483.7
TOTAL	644.4	2606.9	6761.7

A.2.2.2.1 Baseline

Recently, there has been a great deal of interest in the mobile radio market. Numerous studies (6,7,8) have been done by AT&T, Motorola, MCI, Western Union and others in support of their tariff filings (these may be obtained at the FCC). Filings for the top 30 cities are currently at the FCC and we have reviewed much of the marketing information. In addition, Western Union has gathered a great deal of information by having filed either along with or as a partner in 15 of the top 30 markets. This has involved a large market survey and extensive research in those markets. Western Union, along with dozens of other companies, is currently preparing filings for other cities.

Based on the information from these sources, it was possible to estimate the number of mobile phones in 1980, 1990 and 2000 (see Table A-9). Using the Western Union market analysis for Kansas City, the projected average number of calls per day is three per phone. This number can be expected to rise over time, but just slightly (B). This times the number of phones gives the number of calls per business day (C). Applying the peaking factor (D) based on Western Union's internal analysis, gives the number of calls during peak times (E). Average holding time per conversation is currently 2.5 minutes. Using the results of the Chicago and Baltimore/Washington tests, one could expect this figure to rise to 6.4 minutes by 1990 and seven minutes by 2000, which is much closer to the use of the average business telephone (F and G). Multiplying this gives the number of Erlangs (H). The ratio of phone calls between large and small systems was made based on an internal estimate. The number of systems was also projected to grow (J). The 1980 numbers are based on the FCC requesting applications for the first 30 cities and then the next 100. Multiplying the percent of traffic times Erlangs gives Erlangs by large and small systems (K). Dividing by the number of cities in each system gives the number of Erlangs per city (L). Using the "Trunk-Loading Capacity --Full Availability Tables" and a service performance of .05 gives the number of duplex trunks needed to handle the traffic in each city (M). Multiplying by the number of cities in the system gives the total number of trunks required (N). Estimates of the percentage of long distance traffic ranged from 10 to 25% of total traffic; 18% was chosen as a reasonable estimate (O). Multiplying the percent of long distance traffic by the number of trunks required gives the number of long distance trunks required.

TABLE A-9
MOBILE RADIO TRAFFIC FORECAST

	All Systems 1980	1990	2000
A. Phones	158K	1,600K	3,900K
B. Calls per phone	3	3.5	4
C. Total calls	474K	5,600K	15,600K
D. Percent peak hour	15%	15%	15%
E. Calls during peak	71K	840K	2,340K
F. Holding time plus overhead	2.5	6.4	7.0
G. Holding time - minutes per hour	.042	.108	.117
H. Erlangs	2,986	90,720	273,780

	Large Systems			Other Systems		
	1980	1990	2000	1980	1990	2000
I. Percent of traffic	67	67	67	33	33	33
J. Number of systems	30	40	50	100	125	150
K. Erlangs	2,001	60,782	183,433	985	29,938	90,347
L. Erlangs per city	66.7	1,520	3,669	9,85	240	602
M. Trunks needed per city	73	1,600	3,815	16	263	640
N. Total trunks	2,190	64,000	190,750	1,600	32,875	96,000
O. Long distance	18	18	18	18	18	18
P. Long distance trunks required	394	11,520	34,335	288	5,918	17,280

	1980	1990	2000
Large	394	11,520	34,335
Small	288	5,918	17,280
TOTAL	682	17,438	51,615
Half-Voice Circuits	1,364	34,876	103,230

Table A-9 gives the number of full duplex trunks needed for each type of system. This number times two gives the number of half-voice circuits required for 1980, 1990 and 2000.

A.2.2.3 Voice Store-and-Forward

Voice store-and-forward, a computerized storage-retrieval system for distribution of voice message communications, is one of the features of the "office of the future" which is here now.

Voice store-and-forward is similar to its text counterpart, electronic mail, in that messages are stored in digital form for convenient delivery at a later time. With voice store-and-forward the user simply dictates the message over the telephone instead of typing it. Ultimately, voice store-and-forward will be integrated with its text counterpart to form an integrated messaging system.

Each user of the system is assigned a "mailbox" which stores voice messages from other users in digital form. To retrieve their messages, users simply call the system from any keypad-equipped telephone. After hearing the message, a user may reply immediately and the system will automatically deliver the response to the original caller.

Following is a partial list of vendors supplying voice store-and-forward systems:

a. ECS Telecommunications - "Voice Message Exchange" (VMX)
b. Solid State Systems - "Voice Storage System"
c. Honeywell/Action Communications - "Watsbox"
d. IBM - "Audio Distribution System" (ADS)
e. Wang Labs - Digital Voice Exchange (DVX)
f. Dialcom, Inc. - "Intercomm"
g. BBL Industries - "Voice Mail System"

Equipment and services for store-and-forward message systems are expected to grow at an annual rate of 45% through 1990; the greatest growth will occur in the area of Voice Store-and-Forward Message (VSFM) systems. Beginning around

1985, medium to large-sized businesses will begin to utilize VSFM services integrated with new or pre-existing PABX systems.

According to ECS Telecommunications representatives there are now more than 22,000 users of voice mailboxes throughout North America, and in the first year and a half more than ten million voice messages have been sent. As an inducement to buy their product, ECS Telecommunications Company is offering access via a free 800-number from any user to pilot test their voice mailbox service.

One of the larger users of Voice Message Exchange (VMX) services is the Westinghouse Corporation. Presently, they have 900 professionals and managers using their voice mailbox system. Users are located at Westinghouse facilities around the country and the globe. Nearly 70% of the users employ the service regularly, sending an average of two voice messages per day. Many employees use VMX to leave voice messages as reminders to themselves; others use it to broadcast messages to all staff members within a group. It is reported they now conduct approximately 20 to 25% of their interoffice communications through the Voice Message Exchange. Prior to VMX, "Regular telephone calls averaged five minutes, VMX calls now average just 1.5 minutes," according to the Westinghouse Manager of Communications.

Voice store-and-forward systems will become integral part of business telecommunications. Therefore, instead of determining the amount of traffic which it will eventually generate, it was decided to treat it as a market determinant factor under voice applications affecting business message telephone traffic.

A.2.3 Radio Services

Satellite transmission of radio programming has seen an explosion over the last five years. This growth occurs as existing networks switch to satellite distribution and the number of networks increases to meet listener demand. Satellite distribution will continue to grow because economies of production and emergence of new radio stations will increase the demand for network programming. The prospect for growth in radio program transmission is very good in the near future and continues to be good through the end of the century.

The demand for radio networks results from a variety of economic, technical and regulatory factors. The number of radio stations has more than doubled between 1968 and 1978; from 4,000 to over 8,500 stations. This movement is likely to continue as the FCC takes actions which increase the number of stations any one market can have and as more markets become saturated. The introduction of new services such as AM Stereo, CATV all music channels and recording channels will also spur the formation of new networks.

Perhaps the biggest push for national networks will come from the desire to segment the market. Public radio, with its plans to go to 24 channels, is doing this now. More religious stations will pool their resources to market to their respective audiences. The National Black Network is aiming at a segment. A review of other channels reveals the Wall Street Journal's "Reports", "Beautiful Music," "Rockline" and others which are aimed at certain market segments. Satellite transmission offers the opportunity to reach widely dispersed small pockets of the population which have been underserved up to now.

In order to project the future demand for radio, the market is divided into five segments: Public Radio, Commercial Radio, Occasional Radio, CATV Music and Music Recording Channels. Each of these sections is discussed below and the baseline forecast for radio broadcast is then explained.

A.2.3.1 Public Radio

The National Public Radio (NPR) network pioneered satellite transmission of radio programming in 1978. Under current plans, NPR will become the largest single radio network in terms of number of channels and variety of programming, going from 8 channels in 1980 to 24 in 1983 (9). NPR will include dramatic programming, specialized audience programming, educational programming and extended program service. The wide range of NPR programming is the product of a variety of listener demand and NPR's attempt to meet this demand.

A.2.3.2 Commercial and Religious Radio

The number of commercial radio networks has increased greatly over the last two decades, from four networks in 1960 to over twenty today. These networks

generally provide news and entertainment programming, although a few networks provide exclusively news or entertainment. Entertainment programming is predominantly music, with many networks airing live concerts. Available networks cover the entire range of today's music from top 40 to classical and pop to soul. There are also several religious broadcast networks, the PTL network being one example.

The first commercial network to use satellite transmission was RKO in 1979. RKO has two networks and will open their third network shortly. A review of satellite transponder usage reveals that approximately 13 channels of commercial radio traffic are currently being carried. Religious broadcasting is being carried on three channels.

A.2.3.3 Occasional Radio

Most regional or national use of radio programming comes from the broadcast of an occasional event. Religious broadcasts, sports, live concerts, simulcast of live TV and other events fall under this category. Occasional radio is interspersed with a station's regular programming whereas network radio becomes a station's regular programming.

A.2.3.4 CATV Music

Cable operators are finding it very popular to include a channel or two of music along with their regular video broadcast. This can be supplemented with concerts or interviews to be a full channel offering. New franchises are offering around 100 stations and will need something to fill the gap between available programming and the number of stations offered.

A.2.3.5 Recording Channel

A new service which could revolutionalize the music recording industry by 1990 is in its infancy. Digital Music Company has begun broadcasting two channels of very high quality music which may be recorded by making arrangements in advance. This is expected to provide a cheaper means of distribution, especially for recordings with low demand such as Mozart. Two audiences are expected to

be attracted to this offering: those living in areas where certain music is difficult to obtain and music buffs wanting the highest qual!ty recording available. Digital music is expected to start with two channels this year, which would be scrambled to households that had not paid to tape the record.

A.2.3.5.1 Baseline

In order to determine the baseline forecast for radio broadcast applications, the five services were reviewed to determine their current and future demand. This demand is expressed in terms of channels (see Table A-10) required to carry the service. This process included:

1. Determining what channels were currently using satellite transmission.
2. Determining the announced plans for new channels over the next five years.
3. Projecting a growth rate based on the expected changes in each service and making a judgement as to how many channels will be required in 1990 and 2000.

Channels were then converted into transponders (see Table A-10) by considering such thir s as using SCPC transmission and transmitting to 3 meter antennas across the nation. In order to assure a high quality transmission, Western Union Engineering Group has estimated that 30 channels would be an appropriate number for a transponder under the above conditions.

In order to keep all voice transactions in half-voice circuits the number of transponders required was multiplied by the number of half-voice circuits per transponder in 1980, 1990, and 2000 as determined by Western Union engineers (see Table A-10).

A.2.4 Summary of Voice Baseline Forecast

The baseline forecasts for the specific voice services are presented individually and as a total in Table A-11. The corresponding growth rates are noted in Table A-12.

TABLE A-10
RADIO TRAFFIC FORECAST

	CHANNELS		
	1980	1990	2000
Public	8	30	33
Commercial and Religious	13	33	40
Occasional (weekend peak)	30	40	45
CATV Music	2	10	15
Recording	0	5	10
TOTAL	53	118	143

	TRANSPONDERS		
	1980	1990	2000
Public	.267	1.000	1.100
Commercial and Religious	.433	1.100	1.330
Occasional (weekend peak)	1.000	1.330	1.500
CATV Music	.067	.333	.0.500
Recording	0	.167	.333
TOTAL	1.777	3.930	4.763

	HALF VOICE CIRCUITS		
	1980	1990	2000
Public	320.4	1800.0	2640.0
Commercial and Religious	519.6	1980.0	3192.0
Occasional (weekend peak)	1200.0	2394.0	3600.0
CATV Music	80.4	599.4	1200.0
Recording	0	300.6	799.2
TOTAL	2120	7074	11431

TABLE A-11. VOICE BASELINE

(THOUSANDS OF HALF-VOICE CIRCUITS)

SERVICE	YEAR 1980	1990	2000
MTS (Residential)	593.0	1279.0	2639.0
MTS (Business)	1588.0	4118.0	8890.0
Private Line	644.4	2606.9	6761.7
Mobile	1.4	34.9	103.2
Public Radio	.3	1.8	2.6
Commercial & Religious	.5	2.0	3.2
Occasional	1.2	2.4	3.6
CATV	.1	.3	1.2
Recording	0	0	.8
TOTAL	2828.9	8045.3	18405.3

TABLE A-12. VOICE BASELINE - GROWTH RATES (ANNUAL, %)

SERVICE	TIME PERIOD 1980-1990	1990-2000
MTS (Residential)	8.0	7.5
MTS (Business)	10.0	8.0
Private Line	15.0	10.0
Mobile	37.9	11.5
Public Radio	19.6	3.7
Commercial and Religious	14.9	4.8
Occasional (Radio)	7.2	4.1
CATV Music	11.6	14.9
Recording (Radio)	0.0	0.0

A.3 DATA APPLICATIONS

There are several trends which indicate that the volume of data transmission will increase substantially in the coming years. The United States is moving toward a service/information oriented society. As this occurs, there is a need to increase the productivity of white collar workers. The harnessing of microchip technology with its favorable price to performance ratio has begun to answer this need. As computers become more commonplace in toys, automobiles, and banking, society is learning just how powerful and just how simple to operate a computer can be. This in turn is lowering the business community's natural resistance to change. Acceptance of computer technology combined with huge price drops have made the computer an invaluable tool at all levels and for all sizes of business. An explosion in the market for home computers for entertainment, finances, and information also is just around the corner. Complementing these trends is the merger of communications and data processing. The amount of information passed from computer-to-computer will grow tremendously as this takes place.

In order to develop a baseline forecast for data, seventeen services were defined. Some services shared common traits and were, therefore, grouped together for ease of forecasting. These services and groupings are indicated below:

Terminal Operations	Data Transfer
	Batch Processing
	Data Entry
	Remote Job Entry
	Inquiry Response
	Timesharing
Electronic Mail	USPS EMSS
	Mailbox Services
	Administrative Message Traffic
	Facsimile
	Communicating Word Processors

Record Services	TWX/Telex Mailgram/Telegram/Money Order
Other Terminal Services	Point of Sale Videotex/Teletext Telemonitoring Secure Voice

The first six services all deal with general purpose terminals and the transfer of data. Traffic projections primarily were based on the terminal population. Traffic projections for the three services under electronic mail depend to a great extent on the amount of traffic which is diverted from other forms such as first class mail or intercompany mail. The other two services under electronic mail are projected based on the number of machines in use, frequency of use, and the length of the average business transmission. Record services are handled largely by Western Union and projections are based on actual traffic figures and long-term trends. The four services under the other terminal services categories used identifiable terminals which were unique and are projected based largely on discussions with industry sources.

For the seventeen data services, all traffic is stated in terms of terabits (bits x 10^{12}). One bit of information is either a "1" or "0" and it usually takes 8 bits to represent a character such as an "a". Since bits are used by computers and any form of digital transmission, it is natural to state the traffic in this way.

A.3.1 Terminal Operations

The first six of the data services have been classified as terminal operations. The base for all of these services is derived based on the terminal population in the United States. This refers to general purpose terminals which are commonly used to input or receive information from a computer. It includes home computers but not point of sale transactions which require unique equipment.

A.3.1.1 Data Transfer

Data transfer is a process in which information is electronically transferred from one storage bank to another in a non-update fashion. The transfer usually takes place during the off-peak transmission time. This application is used by insurance companies, financial institutions, the banking industry, and the like. The transmission speed in bits per second (bps) will depend on the volume of data to be transferred. For large amounts of data, the speed is usually 56 kbps and up. Electronic fund transfer systems and point of sale systems could also make use of this application.

A.3.1.2 Batch Processing

Batch processing is a procedure that is volume rather than time oriented; it is prepared according to a schedule rather than on demand. Typical examples include daily sales orders, weekly payroll information, etc. Usually batch processing is implemented on transmission facilities with speeds higher than 56 kbps.

A.3.1.3 Data Entry

In data entry, the information is captured in complete readable format at its source and added to an existing data base, eliminating the intermediate keypunch mode. Equipment used in this application includes general purpose as well as application unique terminals. The facility speed depends on the volume of data and may vary anywhere from 2.4 kbps to 56 kbps or up. Typically, data entry can be utilized for electronic funds transfer systems such as those used by the banking industry and financial institutions and point of sale applications used by the retail industry.

A.3.1.4 Remote Job Entry

Remote Job Entry (RJE) is the process of remotely controlling the initiation and termination of computer processing related to a specific job or run. Essentially, this remote control capability affords an operator the same level of processing capability as if he were within the computer facility. It differs from data entry

in that RJE involves manipulation of the received data and transmission of the output to the originator after processing. This application will typically be used by universities or any organizations with dispersed locations. The speed of transmission ranges from 1.2 to 9.6 kbps.

A.3.1.5 Inquiry/Response

Inquiry/Response is characterized by its urgency and is usually transmitted in a real time manner through operator-entered inquiries to an existing data base which can then be manipulated and corrected. Common applications include airline reservation systems, stock exchange quotations, inventory status and account balances. The speed of transmission may vary from 1.2 to 9.6 kbps.

A.3.1.6 Timesharing

Timesharing is the shared use of centrally located computer facilities by several operating entities. The computer facilities can store, manipulate and transmit data simultaneously among the several users, generally on a real time basis. The supplier of the central computer facilities may be a commercial organization serving many unassociated users, known as commercial timesharing, or a private supplier serving in-house computing needs, referred to as private timesharing. The transmission speed will also vary from 1.2 to 9.6 kbps.

A.3.1.7 Baseline for Terminal Operations

To estimate the magnitude of terminal operations traffic, the following procedure was used.

a. Estimate the number of data entry terminals in 1980 and the projected growth pattern for the years 1990 and 2000.
b. Estimate the number of terminals being used for various services.
c. Estimate the average thruput of each terminal. This estimated thruput is a function of the following:
    1. Number of bits transmitted per character
    2. Average number of characters per second transmitted

3. Number of hours per year the terminal transmits.

The Market Research Department of Western Union has estimated the 1980 and expected future traffic of data comn.unication. This information was published in the report by Western Union [10]. The Western Union Market Research Department has developed most of the data from a compilation of many existing market research reports, primarily those of International Data Corporation[11,12,13,14], Yankee Group[15], Future Systems Incorporated[16,17], Prodcasts[18] and Author D. Little[19]. In general, a consensus approach was used for conclusions presented in this document. However, on certain occasions, the opinions, and sometimes judgment, of Western Union's Market Research Department was given a relatively heavy weighting.

Western Union's report estimated the total installed base of terminals in 1980 to be 7 million increasing to 21 million by 1990, an annual compounded growth rate of 11.6%. That report estimated that 70% of a potential 30 million white collar users will be using terminals by 1990. The growth will be fastest in the earlier half of the decade and slow down during the later half as the saturation of the potential users takes place.

Furthermore, a summary of the findings published by the U.S. Department of Commerce[20] indicated an increase of 11.6% in the shipment of computers in 1980 over 1979. It is, therefore, Western Union's opinion that, barring any serious downturn in the U.S. economy, an 11.6% compounded growth rate in data communication is realistic and achievable.

Subsequent to the estimation of the computer terminal population, the next step was to estimate the data entry terminal equipment that communicates with other computer equipment in an internal or external network. In a research report published by International Data Corporation[12], the following results were obtained as a consequence of random sampling of terminal users:

> Based on 594 terminals in operation at various survey sites, 58% of the terminals in this industry grouping communicate with an in-house host computer. 11% of the total number of terminals communicate with a host computer at another location. 6% of the total operate

with a service bureau, which is followed by 3% communicating with externally located terminal equipment. A sizable group of 22% of the total terminals are used in an off-line mode.

As the next step to arrive at projections for data traffic demand, the average number of bits per year originated by each terminal engaged in communication with an outside computer was needed. The following statistics were obtained from a study conducted by the Yankee Group[21].

less than one hour	14.6%
one to two hours	18.1%
two to four hours	21.1%
four to six hours	16.1%
six to eight hours	29.8%

An average usage of four hours per day is derived from the following:

$$\text{Average Usage Time} = \frac{0.5 \times 14.6 + \frac{(1+2)}{2} \times 18.1 + \frac{(4+2)}{2} \times 21.1 + \frac{(4+6)}{2} \times 16.1 + \frac{(6+8)}{2} \times 29.8}{100}$$

$$= 3.87 \text{ hours} = 4 \text{ hours}$$

Since no published statistics are available for the number of characters per second, a statistically "representative" terminal-to-computer transaction has to be determined. While many different transaction types may be postulated, an appropriately chosen representative transaction serves to define a data rate reasonably close to the average thruput at each terminal. A typical terminal-to-computer transaction is postulated as follows.

The transaction begins with a human input, assumed to be 80 characters long and limited in speed by the keyboard entry to about 5 characters per second. After a five-second response time, which allows for communications turn around and queuing and processing delays, the computer responds by painting the screen with 500 characters of data (one-fourth of a typical full screen). The elapsed time,

using 9600BPS line speed for this 500/960 transaction, is 0.5 seconds. Twenty-five seconds are then allocated for absorbing the information presented, and an additional five seconds is assumed to elapse before the operator begins the next transaction. A total of 51.5 seconds is required for the complete transaction, during which 580 characters are transmitted in one direction or the other. Thus, the average speed during the transaction is 580 divided by 51.5, or 11.2 characters per second. Assuming that the average terminal is in use 250 days per year and 4 hours per day, and assuming 10 bits per character to allow for communications overhead, the result is a communications load of 400 M bits per year (10 bits per character X 250 days X 4 hours per day X 3600 seconds per hour X 11.2 characters per second).

Since there are no available statistics on the number of terminals dedicated to various services, the number of terminals allocated to various services was estimated based on the opinions of Western Union's marketing department and relevant information derived from other published sources.

As noted above, it has been estimated that about 7 million terminals were in use in 1980. International Data Corporation's findings indicate that about 42% of the terminal population is engaged in communications with a distant host or central computer. It is estimated that about 25% (one million) of the remaining 58% (four million) are involved in terminal-to-computer transmissions. Since data transfer and data entry are volume oriented, the terminal allocation for data transfer and data entry is adjusted by 400,000 and 600,000 respectively. The average terminal usage time for data transfer and data entry has increased from four hours to six hours for year 2000. For the remaining services the usage time is maintained at four hours per day.

The communication traffic forecast for 1990 is based on 1980 traffic estimates. Western Union's market studies(10,22) indicated that by 1990, the terminal population will rise to 21 million, an annually compounded increase of 11.6%. Similarly to the 1980 estimate for data transfer and data entry terminals, the terminal population is enhanced by 1,210,000 and 1,830,000 terminals respectively. For the year 2000 estimates for data transfer and data entry terminals the population is enhanced by 3,610,000 and 5,490,000 respectively.

Proliferation of small business and personal computers will have a significant effect on communications requirements. A marketing report by Frost and Sullivan[23] predicts that nearly four million small business computers will be sold during the 1980s.

Although "home communications centers," increasingly popular due to the rapidly declining prices of personal computers, are not fully evaluated, they could have significant impact on communications requirements as more and more information services are furnished to potential users. It is estimated that in 1990 about 4 million home computers will be in use with a potential capture of 50% (2 million) of the market in communications activity. Assuming a 6% annual increase in home computers, 3.5 million will be used in communications by the year 2000. Therefore the population for data entry was augmented for these years.

For the year 2000, an estimated 11.6% annual increase in terminal population is expected for data transfer, data entry and inquiry/response, and 6.0% for batch processing, remote job entry and timesharing. The communications data traffic estimates for the year 2000 were based on emerging trends in the business world, technological advances and expected cost reductions in commmunications equipment. Some of the significant factors which will impact future data communications requirements can be envisioned as follows:

a. The entry of large financial institutions such as banks, insurance companies, brokerage firms, and large retail stores into "one stop" financial services.
b. Increasing proliferation of small computers for home information centers and small business establishments.
c. Aggressive growth fueled by technological changes and rapidly falling prices.
d. Specialized services that are beginning to be offered by new companies.

The allocation of terminals to various services for 1980 is as follows:

Data Transfer	26% of 2.94M	=	760K	+ 400K	=	1,160K
Batch Processing	26% of 2.94M	=	760K			
Data Entry	12% of 2.94M	=	350K	+ 600K	=	950K
Remote Job Entry	14% of 2.94M	=	412K			
Inquiry/Response	14% of 2.94M	=	412K			
Timesharing	8% of 2.94M	=	235K			

The number of terminals for the years 1990 and 2000 are calculated in accordance with the 1980 population as the base line. The terminal operations forecasts are presented in Table A-13.

A.3.2 Electronic Mail

Electronic mail is similar in many ways to regular first class mail. It is the handling of text by electronic means. The following services fall under electronic mail:

a. USPS EMSS
b. Mailbox
c. Administrative Message Traffic
d. Facsimile
e. Communicating Word Processor.

A.3.2.1 United States Post Office Electronic Mail Switching System

On January 4, 1982, the United States Postal Service (USPS) introduced Electronic Computer Oriented Mail (ECOM). ECOM users will transmit correspondence in digital form via telephone lines to a serving post office (SPO) in one of 25 major cities. The SPO then automatically prints the letters out on paper, folds them, inserts them into envelopes, and mails them first class within two days to their destination. ECOM users can also send their messages to Western Union Electronic Mail, Inc. (WUEMI) from any compatible communicating word processor, computer-generated tape, or facsimile terminal for conversion to ECOM format. WUEMI has on-line at least 43 types of terminals made by 33 manufacturers which interface with ECOM hardware.

TABLE A-13. SERVICE IDENTIFICATION FOR DATA TRANSMISSION

	Number of Terminals 1980 ($\times 10^3$)	Bits per Year per Terminal ($\times 10^6$)	Bits per Year 1980 ($\times 10^{12}$) C1 x C2	Number of Terminals 1990 ($\times 10^3$)	Bits per Year 1990 ($\times 10^{12}$) C2 x C4	Number of Terminals 2000 ($\times 10^3$)	Bits per Year per Terminal ($\times 10^6$)	Bits per Year 2000 ($\times 10^{12}$) C6 x C7
Data Transfer	1,160	400	464	3,500	1,400	10,400	600	6,240
Batch Processing	760	400	304	2,300	912	4,100	400	1,640
Data Entry	950	400	380	4,900	1,960	12,200	600	7,320
Remote Job Entry	412	400	165	3,200	1,295	5,800	400	2,320
Inquiry/Response	412	400	165	3,200	1,295	9,700	400	3,880
Timesharing	235	400	94	700	268	1,300	400	520
TOTAL	3,929		1,572	17,800	7,130	43,500		21,920

Note: Due to round-off some numbers may be slightly different

Presently, only bulk users are availing themselves of the service since a minimum of 200 messages must be sent per transmission. Businesses may send out bills, direct mail solicitations, or other large volume mailings. All popular computer communications interface, enabling users to establish a direct link between their computer systems and an ECOM computer located at an SPO or an indirect link through a public computer network.

Common carriers are opposed to ECOM's intervention into an already competitive market. They argue that the USPS may divert revenues from other classes of mail to support it. Since ECOM mail is eventually delivered first class, mail from the SPO's might take the same time to send from the user's home territory or across the country. Only if the SPO's were linked via communications channels would this method prove more efficient.

USPS will have fierce competition from other computer based message systems (CBMS) and local networks providing electronic mail service in the 1980s. It is estimated at least 60% of first class mail involved in business or government financial transactions could be diverted to pre-authorization; potentially, half USPS's revenue could be lost due to Electronic Funds Transfer (EFT). USPS costs are relatively fixed; if volumes decrease, revenue will suffer.

USPS must try other means to divert message traffic. It is estimated that the following 1980 traffic could be diverted:

SOURCE	BILLION MESSAGES PER YEAR
Electronic Public Message Services	0.89
Transactions and Data Entry Traffic	3.60
Batch and File Transfer Traffic	10.00
Potentially Diverted Mail	27.50
Substitutable Voice Telephone	1.74
Total	44.73

Hence, 44.73 billion messages per year could be diverted to ECOM services. If messages from these sources increased by an average of 4 billion per year until 1990, anticipated message traffic would be 84.73 billion messages per year.

If only 50% of this total were diverted to ECOM by 1990, a total of 338.4×10^{12} bits per year would be transmitted.

$$\frac{84.7 \times 10^9}{2} = 42.3 \times 10^9 \text{ messages per year}$$

$$42.3 \times 10^9 \text{ messages per year} \times 1{,}000 \text{ characters per message} \times 8 \text{ bits per character} = 338.4 \times 10^{12} \text{ bits per year}$$

If the amount of potentially diverted mail continued to grow by an average of 4 billion messages per year by the year 2000 message traffic transferred to ECOM and similar services would total approximately 996.8×10^{12} bits per year. The USDS/EMSS Traffic Forecast is presented in Talbe A-14.

A.3.2.2 Mailbox

A computer mailbox system is related to computer message switching in the same relationship that a postal service box is related to home delivery. In message switching, the computer delivers the mesage to a terminal or notifies the terminal of a message that is waiting. In computer mailbox, the user must check the box, which is in some preassigned location in the computer's memory, typically a disk file.

Mailbox service evolved within the scientific and academic communities among users who all shared the same computer network for timesharing purposes. Mailboxes are set up to allow store-and-forward message switching. It is a very useful service when the user travels and uses the network frequently. In an environment where many users share only a few terminals, message switching rather than mailbox service should be used.

Presently, mailbox and message switching systems are often separate, with mailbox systems unable to deliver messages. In the future, these two will probably be merged so that a user can either call in as if the system had a mailbox or have the message delivered automatically when the assigned terminal registers that it is available for delivery.

TABLE A-14. USPS/EMSS TRAFFIC FORECAST
(terabits)

YEAR		
1980	1990	2000
0	338.4	996.8

Leading providers of electronic mailbox systems include: Dialcom, Computer Corporation of America (Comet), General Electric Information Services (QUIK-COMM), I. P. Sharp, CompuServ, and Source Telecomputing. Together they share an estimated $25 million market for 1982.

The entry of AT&T's Advanced Information Service (AIS) packet switching network into this market will greatly accelerate the growth of message services with accent on mailboxes as increased postal rates continue to exceed the cost of electronic mail. AIS will capture a much broader market than the other packet services, including a home market and a substantial small and medium-sized business market. By the year 1992 the electronic mailbox and store-and-forward message switching market could amount to as much as $500 million, with AT&T in control of $350 million. Other vendors expected to enter this market include ITT, RCA, Federal Express, and MCI (which is acquiring WUI).

Dialcom claims to have 12,000 mailboxes (giving one to each of its timeshare customers). Tymnet's "OnTyme" has 2,500 to 3,000 mailboxes. Every electronic mail system uses Telenet, Tymnet or direct dial to send messages. For example, Comet has access to Tymnet and Telenet and had 2,000 subscriber mailboxes on its network (representing 60 companies) and had sold 11 private systems (approximately 3,500 mailboxes) by August 1980.

The mailbox traffic forecasts are presented in Table A-15. To determine the number of bits per year the following assumptions were made:

a. Two to three messages per day per user
b. Each mailbox has one user
c. Each message contains approximately 1,000 characters with 8 bits per character
d. Twenty-two working days per month.

On the basis of these assumptions it was estimated that there were .32 terabits per year of mailbox traffic in 1981. Assuming a 50% growth rate between 1980 and 1981, the 1980 traffic amount was calculated to be $.213 \times 10^{12}$ bits per year. About a 35% growth rate was assumed for the period 1980-1990 and a 10%

TABLE A-15. MAILBOX TRAFFIC FORECAST

NUMBER OF BITS PER YEAR - 1981

	Number of Mailboxes	Percent	Number of Messages Per Year	Number of Bits Per Year
QUIK-COMM (GE)	20,000	41	15.8M	0.12×10^{12}
DIALCOM	12,000	25	9.5M	0.08×10^{12}
TELEMAIL (by Telenet)	8,000	16	6.3M	0.05×10^{12}
COMET (CCA)	3,000	6	2.4M	0.02×10^{12}
INFOPLEX	3,000	6	2.4M	0.02×10^{12}
ON-TYME II (Tymet P/O Tymeshare)	3,000	6	2.4M	0.02×10^{12}
TOTAL	49,000	100	38.8M	0.31×10^{12} (0.31 terabits per year in 1981)

NUMBER OF TERABITS PER YEAR

1980	1990	2000
0.213	4.9	12.7

growth rate for the period 1990-2000. The resulting 1990 and 2000 forecasts are presented with the 1980 forecast in Table A-15.

A.3.2.3 Administrative Message Traffic

Administrative messages are usually short (approximately 1,000 characters) person-to-person messages. Examples include travel information, new product announcements, performance reports, and non-record keeping tasks.

Administrative messages differ from data communication messages in that data communications are usually in numeric form. Some examples are data base entry, inquiry/response, remote job entry or batch processing data. Much of this traffic (approximately 25 billion intracompany messages) is still delivered manually through company mail rooms. However, there is a rapidly rising trend to transmit administrative messages via computer base message switching (CBMS) systems and communicating word processors (CWP). Companies may select from a variety of CBMS suppliers ranging from value-added carriers and vendors of public message services to software houses and manufacturers of larger mainframe computers and automated office equipment. A number of vendors, among them Telenet and Tymnet (non-military) and ARPANET and AUTODIN (military), provide external packet switching networks linking their users. AT&T's recently introduced Advanced Information System (AIS) will provide a packet network with a broad range of messaging capabilities. With the advent of office automation, many companies are purchasing their own private local networks providing high speed, short haul multi-dropped party line links to which a variety of electronic equipment may be attached.

A.3.2.3.1 Baseline

Administrative message traffic will be routed through CBMS systems and packet switching networks. Message traffic volumes for both government and non-government use will encompass all of these. In 1980, 50 million messages were delivered through CBMS while 95 million messages went via packet switching networks.

Among those agencies studied were the Federal Reserve Bank, the Veterans Administration, the Federal Bureau of Investigation, the Department of Justice, the Department of the Interior, and the Department of Agriculture as well as many smaller governmental entities. A breakdown of the approximate number of leased circuits at each baud rate is shown below:

(A) SPEED (BPS)	(B) NUMBER OF CIRCUITS	(A) X (B) (KBPS)	TOTAL MBPS IN THE PEAK HOUR
300	208	62.4	224.6
2400	1,580	3,792.0	13,651.2
4800	630	3,024.0	10,886.4
7200	6	43.2	155.5
9600	544	5,222.4	18,800.6
56K	79	4,424.0	15,926.9
250K	8	2,000.0	7,200.0
1.5M	6	9,000.0	32,400.0
		27,568.0	99,244.7

Rounding off the total of 99,244.7 Mbps in the peak hour to 1×10^5 Mbps, a conservative estimate is that peak hour traffic is half the daily traffic in a 22 day month. Thus, the annual total of bits transferred is 52.8 trillion bits.

If we include Western Union's Advanced Record System (ARS) with its 0.6 trillion bits of traffic per year we get a total of 53.4 trillion bits per year in non-military message traffic.

Military traffic is handled commercially by two major switching systems, AUTODIN and ARPANET.

AUTODIN I	10.0	trillion bits per year
ARPANET	5.1	trillion bits per year
TOTAL	15.1	trillion bits per year.

The combined military and non-military traffic flow follows:

Non-military	53.4	trillion bits per year
Military	15.1	trillion bits per year
Total	68.5	trillion bits per year

Assuming that 25% of this traffic may be considered administrative, government message traffic in 1982 totaled 17.1 trillion bits per year.

Using a growth rate of 12% for the last few years, we arrive at a 1980 baseline figure for government administrative message traffic of 15.3 trillion bits per year.

There are approximately 3,500,000 non-government terminals which presently engage in data transfer, batch processing, data entry, remote job entry, inquiry/response and timeshare in mid-1982.

a. Assuming 25% of these are used for administrative message traffic, then:
   3.5×10^6 terminals $\times$ .25 = 0.88M terminals are used for administrative traffic

b. If each terminal transmits approximately 20 messages per day, the daily administrative message traffic is:
   $.88 \times 10^6 \times 20 = 17.6 \times 10^6$ messages per day

c. Assuming a 22 day working month:
   17.6×10^6 messages per day $\times$ 22 days per month $\times$ 12 months per year = 4.6×10^9 messages per year

d. Average message is approximately 1,000 characters and consists of 8 bits per character:
   4.6×10^9 messages per year $\times$ 1,000 characters per message $\times$ 8 bits per character = 37.2×10^{12} bits per year (mid-1981 to mid-1982).

Assuming we've had a 12% growth rate per year extrapolating back to 1980 equals:

$$\frac{37.2 \times 10^{12} \text{ bits per year}}{1.12} = 33.2 \times 10^{12} \text{ bits per year in 1980 to 1981}$$

The baseline forecast for total government and non-government administrative message traffic in 1980 is 48.5 trillion bits per year.

Government	15.3	trillion bits per year
Non-government	33.2	trillion bits per year
Total	48.5	trillion bits per year

The administrative message traffic for 1980, 1990 and 2000 are presented in Table A-16. The 1990 and 2000 forecasts are based on the following assumptions:

a. In 1990 demand will equal about 600%. at 1980 demand (i.e. average annual growth rate = about 20%).

b. In 2000 demand will equal about 300% of 1990 demand (i.e. average annual growth rate = about 12%).

A.3.2.4 Facsimile

Three of the projected services are considered facsimile. The services are:

a. Convenience Facsimile (CITT Classes 3 and 4)

b. Operational Facsimile (CITT Classes 1 and 2)

c. Special Purpose Facsimile

Each of these services is discussed below, along with their current and expected demand. These forecasts are based on the type and number of machines in place, and an industry estimate of the number of pages transmitted during 1980.

A number of factors will cause this market to increase in the coming decades. The setting of standards by the Consultive Committee for International Telephone and Telegraph (CITT) will encourage international as well as inter-company transmission. The trend among business and government users is toward higher speed machines. These machines will be digital with rates as high as a second per page. Satellite Business Systems (SBS) has already demonstrated

TABLE A-16

ADMINISTRATIVE MESSAGE TRAFFIC FORECASTS

(TERABITS/YR.)

YEAR		
1980	1990	2000
48.5	300	933

this capability through their satellites. As a result, it appears the market for the slower machines (Classes 3 and 4) will decline after 1985.

A substantial market is expected to develop in the private sector, however. Both France and Japan predict a low cost facsimile machine in the near future. Three French companies are currently planning to enter the fax market in the U.S. Their equipment is expected to penetrate the low volume, small business user. In addition, Japan has predicted a market for facsimile machines priced as low as $100 for home use by 1985.

A.3.2.4.1 Baseline

The approach used to project the facsimile markets was as follows:

a. Determine the current and forecasted market for each category of facsimile equipment.
b. Determine the usage associated with each category of equipment.
c. Analyze usage trends for each application.
d. Quantify usage in bits per year.
e. Calculate market demand for 1980, 1990 and 2000.

Convenience Facsimile is defined as the slow to medium speed (2 to 6 minutes per page) machines. Our last report gave an estimate of 167,000 such machines in 1978. A review of market statistics of the machines shipped in this range reveals that in 1980 approximately 210,000 machines were in place. The number of pages sent in 1980 is estimated at 214 million, or 102 pages per month per machine. According to industry estimates the growth rate for slow facsimile is expected to remain high, at around 25%, through the middle of this decade. This growth is, however, expected to decline toward the end of the decade and remain around 10% during the 1990s largely due to two factors:

a. Industry will demand higher speed facsimile.
b. The merging of facsimile with communicating word processors is expected to occur within the 1985 time frame.

Using a typical analog machine in place, it is possible to estimate the total number of bits transmitted per year. A machine which scans 100 x 100 points per inch will transmit 935,000 bits per page. At 4800 bps, a page takes three minutes to transmit. This times the estimated number of pages gives a yearly transmission of 200 terabits (bits x 10^{12}).

Operational Facsimile includes medium speed, high speed and wideband facsimile equipment. This equipment operates with a range of one second per page to two minutes per page. Growth in this service seems bright, at least up to 1990, with an expected growth rate of 20 to 35%. Medium speed machines (CITT Class 3) numbered approximately 17,000 in 1980, high speed machines 2,000.

Wideband facsimile machines came into use over SBS satellites in late 1981. Approximately 50 are now in use. Volume of pages transmitted was 200 per day for medium speed machines and 250 for the high speed and wideband machines. It seems unlikely that transmission volume will rise much for the medium speed machines while for the other two it should double by 1990 before leveling off.

For a medium speed machine with a typical 8½ by 11-inch page and a resolution of 100 x 100 lines per inch, there are 935,000 bits of information transmitted. Compression ratios vary from 2:1 to 100:1; in this case, a ratio of 6:1 was used. This gives an actual transmission of 156,000 bits, which at 2400 bps is transmitted in 66 seconds. Similar methods were used for high speed and wideband equipment. The total traffic generated in 1980 by Operational Facsimile was 11.3 terabits (bits x 10^{12}).

Special Purpose Facsimile is the type used by the police for fingerprints or by the weather bureau for maps, and therefore must be very high quality. Industry sources indicate 14,000 machines in operation in 1980 as opposed to 10,000 shown in our 1978 study, giving a growth rate of 18%. A slightly slower growth rate (15%) is indicated through 1990 with a decline (10%) after that due to other technologies. Using a typical machine of 9600 bps with a transmission time of three minutes and no compression (because of the high resolution required) results in 1.73 million bits per page. With an annual usage of 14 million equivalent pages, yearly transmission is 24.2 terabits (bits x 10^{12}).

A review of facsimile user surveys reveals that the current trend is toward higher speed terminals. In addition, many users expect to change from analog to digital equipment. The most important feature of facsimile equipment is its ability to operate unattended. Many users operate across time zones or internationally and need a self-sufficient device. The amount of facsimile use between organizations is on the rise, along with the amount of standardization. One user survey reported a split of 77 to 23% between intra- and inter-organizational traffic.

Bankers Trust New York Corporation, the eighth largest bank in the United States, just started using facsimile in their financial operations. They deal with a number of large users, some with as many as 400 transactions per day. Hexcal, a high technology company in structural components for military aircraft, uses facsimile to send complicated chemical formulas and diagrams, as well as administrative messages. They estimate their headquarters alone sends 700 documents a month. Gulf Oil has just installed a digital system of facsimile distribution with an estimated savings of $256,000 per year. As more and more companies enhance their communications capabilities, facsimile use will continue to grow.

A summary of the facsimile traffic forecasts is presented in Table A-17.

A.3.2.5 Communicating Word Processor

A communicating word processor (CWP) adds communication capability to a printer/keyboard or CRT-based word processing system. This allows the input to be prepared on one system and sent via communication links, at a speed ranging from 1.2 to 9.6 kbps, to another system for output, editing or manipulation. The advantage to the user is the ability to transmit "original" quality documents with format control similar to letter and memo correspondence.

The market for CWPs is expected to enjoy rapid growth in the next decade and to continue to the year 2000. With the addition of such networks as AT&T's Advanced Communication Service (ACS) and other packet networks, the CWP will become the single most important hard-copy device in interoffice communications.

TABLE A-17. FACSIMILE TRAFFIC FORECAST
(terabits)

	YEAR		
	1980	1990	2000
Convenience	200.0	382.3	775.9
Operational	11.3	76.3	211.4
Special Purpose	24.2	85.1	242.7
TOTAL	235.5	543.7	1230.0

A.3.2.5.1 Baseline

In forecasting the amount of traffic generated for each time period, the following steps were taken:

a. Determine the current and projected number of machines in operation.
b. Determine the usage time associated with each machine.
c. Estimate an average speed for each machine used.
d. Calculate the amount of traffic for 1980, 1990 and 2000.

The first Western Union report(1) estimated there were 79,000 CWPs sold in the U.S. in 1980. Industry estimates support this figure. User surveys indicate that the machines were in use on the average of five hours per day. Internal Western Union studies show that actual transmission occurs about 1% of this time in use, or 180 seconds per day. This estimate accounts for those machines not utilizing the communicating capacity as well as those making heavy use of that feature.

Multiplying this number by 250 working days in a year gives a total of 45,000 seconds per year that a CWP is transmitting. With an average machine speed of 4800 bps, this amounts to an annual transmission of 17.1 terabits.

Increased demand for the CWP can be expected to continue over the next decade. Several factors will contribute to this growth, one of which is the increased application of the CWP. For example, as multi-function workstations become more prevalent, office workers will enjoy the ability to send interoffice memos while sitting at their desks. Cost will be another important factor affecting growth. Previous reports showed that the cost of a CWP will decrease to $7,000 by 1984, less than half its cost in 1978. This downward cost trend is expected to continue well into the 1990s, but at a more gradual rate. As the cost of the CWP decreases, this technology will become available to a larger market segment. Finally, the setting of standards for CWP communications will allow different manufacturers' machines to communicate, increasing the flow of information between systems and individuals.

In 1990, the number of CWPs forecast will be 270,000. A modest increase in usage time is expected, increasing the transmitting time per machine per year to 90,000 seconds. (This was held constant in 2000.) Multiplying the number of machines by the usage time and then figuring an average speed of 4.8KBPS produces a transmission demand of 117.1 terabits in 1990.

The usefulness of the communicating word processor will be further enhanced by the availability of public networks supporting its use. This will continue into the 1990s, as will the merging of CWPs with facsimile. Costs are also expected to continue their gradual decline during this decade. Considering the 923,000 communicating machines that are forecast and their average speed of 4.8KBPS, the demand in the year 2000 is projected at 400.3 terabits.

A summary of the CWP traffic forecast is presented in Table A-18.

A.3.3 Record Services

Two of the services being studied, TWX/Telex and mailgram, are record services. The current and projected demand for these services has been the subject of a number of internal Western Union studies. These studies are the basis for the information presented in this section.

A.3.3.1 TWX and Telex

TWX was formed by AT&T in the mid-1930s and Telex was formed by Western Union. Western Union acquired TWX from AT&T in 1971 and has controlled this service since then. Basically, the TWX/Telex service is a switched teletypewriter service operating much as the telephone system does. It is a slow means of communicating, with an operating speed of 45 to 150 bps for TWX and 50 bps for telex. Because of these slow speeds, the network is expected to simply maintain, if not lose, its customer base over the next two decades. Western Union, in an attempt to keep its customers, has introduced new features such as store-and-forward and broadcast services.

TABLE A-18. CWP TRAFFIC FORECAST
(terabits)

YEAR		
1980	1990	2000
17.1	117.1	400.3

A.3.3.1.1 Baseline

In 1980, the installed base of TWX/Telex terminals was 130,000, with almost all these terminals used by business, government or institutions. The estimated number of messages transmitted during 1980 was 150 million. An annual growth rate of 3% is expected during the 1980s and the 1990s. The average message is around 1,000 characters in length, or 8,000 bits, allowing for spaces. This figure times the annual number of messages produces a yearly transmission rate during 1980 of 1.2 terabits (bits x 10^{12}). Using this baseline figure and the expected growth rate, it was possible to predict the message numbers and transmission volumes; these are presented in Table A-19.

A.3.3.2 Mailgram/Telegram/Money Order

Mailgram, telegrams and money orders are all handled by Western Union and are all undergoing changes in response to customer needs. Mailgram message volume has grown steadily since Western Union introduced the electronic mail service in 1970. It combines the speed of Western Union's electronic switching and transmissions facilities with the economy of the U. S. Postal Service's local delivery capability for delivery the next business day anywhere in the U. S. and Canada. Through Western Union's Central Telephone Bureaus or public offices, telex subscribers can transmit mailgram messages directly from their terminals. Also, large volumes of mailgram messages prepared on computer tapes can be transmitted to the company's computer centers from designated offices or customer locations.

A new service known as "Stored Mailgram" is provided by a subsidiary, Western Union Electronic Mail, Inc. (WUEMI). It has grown substantially in the last five years, providing computer storage of frequently used mailgram message texts and address lists which can be accessed by a growing number of communicating word processors in the customer's offices. WUEMI also provides "Computer Letter" to commercial customers who do not need next day delivery. Messages are sent to WUEMI wh e they are processed and deposited with USPS as first class mail. Mailgram is also interfaced to Western Union's InfoMasters computer store-and-forward system.

TABLE A-19. TWX AND TELEX TRAFFIC FORECAST

	YEAR		
	1980	1990	2000
Terminals (thousands)	130.0	174.7	234.8
Messages (millions)	150.0	201.6	270.9
Transmission (terabits)	1.2	1.6	2.2

GR

One of the oldest forms of electronic communication, the telegram, is still used for urgent messages or to make an impact. In the U.S. it is handled exclusively by Western Union and the forecast is based on internal information.

The money order, which is a way of electronically transmitting funds, handles small payments and thus is different from electronic funds transfer. Money orders are also handled by Western Union as well as by other companies.

The information for the market size and number of bits transferred comes from internal analysis. The actual calculation of traffic may be understood by the following tables. Tables A and C are used to derive Table D. Then using the number of bits per message (Table E) it was possible to determine the amount of traffic (Table A-20).

A. COMPARISON OF MESSAGE VOLUME

(millions)

	1977	1978	1979	1980	1981
Mailgram	28.4	32.7	37.4	39.0	40.9
Telegram (Domestic)	6.9	7.0	6.6	6.1	5.3
Money Orders	6.3	7.0	7.7	7.9	8.1

B. COMPARISON OF REVENUE

(dollars)

	1979	1980	1981
Mailgram	78,310	92,824	106,927
Telegram	67,154	64,433	71,008
Money Orders	60,940	70,407	80,718

C. GROWTH RATE

(percent)

	1980-1990	1990-2000
Mailgram	8	5
Telegram	-5	0
Money Orders	12	8

D. MESSAGE VOLUME

	(millions)		
	1980	1990	2000
Mailgram	39.0	84.2	137.1
Telegram	7.9	3.7	3.7
Money Orders	6.1	24.5	52.2

E. BITS TRANSMITTED PER MESSAGE

Mailgram	8000
Telegram	8000
Money Orders	2500

A.3.4 Other Terminal Services

Three of the services projected use special purpose terminals and fall outside the other categories. They are:

- a Point of Sale
- b Videotex/Teletext
- o Telemonitoring
- o Secure Voice

The forecasts for the first two services were done by contacting various industry sources where they would be used. Videotex/Teletext was forecast based on vendor interviews and anticipated machine use.

A.3.41 Point of Sale

A major amount of human drudgery will be saved when payments made by consumers in stores and restaurants are entered directly into the banking system instead of being made by credit card or check. Bank cards are the means of implementing such transactions.

"Point of Sales" (POS) terminals are used for sales transactions, credit authorization and some inquiry functions. Data entry may be made by a magnetic or

TABLE A-20
MAILGRAM/TELEGRAM/MONEY ORDER FORECASTS
(terabits)

	YEAR		
	1980	1990	2000
Mailgram	.31	.67	1.10
Telegram	.06	.03	.03
Money Orders	.02	.06	.13
TOTAL	.39	.76	1.26

optical wand passed over a label which reads and identifies the item, or through entry on a numeric and function key keyboard. Instructions to the operator and data being entered are displayed; data provided in response to an inquiry may be printed.

Cash transactions are handled solely by the interactions of a terminal and a programmed cluster controller located in each store. The programmed controllers operate automonously. Credit and check-cashing authorization, on the other hand, involve a check against a master file at a central computer location. Once a day, another central computer application draws data from all of the connected controllers so as to establish register balances and conduct an overall sales audit.

Another application of point of sale terminals concerns regulation of inventory flow. This application relies on separate display terminals in each store. Order entry is the function which creates purchase orders and inputs them into the purchase order data base. The receiving application verifies quantity and type of merchandise. Invoice data is then entered into the data base as accounts payable, and the cost calculated in terms of retail sales dollars. These functions are executed partly in the controller and partly in the central processor. The interaction is between each display terminal and the central computer via the same controller that handles the sales transactions.

For example, imagine a chain of stores located in several states. In this installation, a group of 20 department stores is being brought on-line, with one programmed controller in each store and a central computer to coordinate them all.

Point of sale terminals are connected to the store's programmed controller via a 2400 or 9600 bps transmission loop. The controllers, in turn, are each connected to the central computer by a separate 4800 bps telephone line. Each programmed controller manages from 60 to 120 point of sale terminals plus a display terminal and a printer. These terminals may handle from 20 to 30 transactions per hour, while the programmed controller in any one store may handle 2000 to 3000 transactions per hour during a peak sales period. Response

time at a POS terminal averages less than a second with fewer than 10% of the responses taking no more than 1.5 seconds.

Each credit authorization requires one or possibly two messages to the central computer. Inventory flow applications may involve as many as 4 or 5 messages per transaction to the central computer. The central computer then must be capable of handling 8 to 10 messages per second during peak sales periods, even though all cash transactions are handled locally using the in-store programmed cluster controller.

When the day's transactions are batched from all the store controllers to the central computer, the transmission must take place within a relatively short time, say 0.5 to 1.5 hours. The central computer must be capable of handling the equivalent of 10 to 20 messages per second for that period of time to transmit the records of tens of thousands of transactions in this mode.

Point of sale terminals are not necessarily communication-oriented devices. Many companies tend to use them in the closed environment of a store without linking them to a network. If they are used locally, then the computer also has to be on-site and that is not practical for a large company with dozens or even hundreds of retail outlets. Rapidly falling computer costs, especially for special purpose microprocessors and less expensive communication facilities, are making it more attractive to link POS terminals to a central site that can handle all of a company's outlets.

Integrated POS systems become cost effective only when a complete merchandise control system is implemented to take advantage of computer data entry as well as sales transactions. Not every retailer needs or can afford such a system.

It is difficult to estimate the number of POS terminals in the marketplace since definitions differ greatly. One 1977 report indicated that there were 151,000 POS terminals in 1977 growing to 590,000 in 1980. This is misleading. One must distinguish between a simple credit authorization terminal (CAT) with limited capability and a true point of sales terminal which can generate inventory information and handle direct debit transactions as well. In 1982, there exist only between 80,000 and 100,000 true POS terminals. As this number grows and

retail chains replace their simpler POS terminals with more sophisticated ones, much more inventory information will be entered and many more direct debit transactions will be made.

The vast majority of POS transactions are handled by credit cards. There are numerous types of cards available. Cards are supplied by commercial banks (VISA and MasterCard), by retail chains (Sears, Pennys and Montgomery Ward), by travel and entertainment concerns (American Express, Diners Club, Carte Blanche) and by the oil companies (Gulf, Texaco, Shell, Mobil, Sunoco and Exxon). Many other concerns also issue credit cards (Hertz, Avis, and National Car Rental) but these are mostly corporate and are on a much smaller scale.

Banks are beginning to issue their own cards which are both debit cards (with immediate withdrawal of funds at time of purchase) and credit cards. Still in their embryonic stage, these cards are replacing a number of regular credit cards and will be used on POS terminals.

A.3.4.1.1 Baseline

Assuming that credit card transactions will grow at an annual rate of 3%, the 50 billion transactions in 1980 will increase to 67 billion in 1990 and 90 billion in 2000. Presently, only 6% of these transactions are handled electronically, most of them primarily for credit card authorization. Each transaction involves on average four messages (two inquiries and two responses). Very little transfer of inventory information or direct debit transactions are performed (an estimated 1000 bits per transaction). As true point of sales terminals (electronic cash registers) become more widespread the percentage of transactions handled electronically will increase sharply with higher volumes of inventory and direct debit transfers being made. By 1990 80% of these transactions should be accomplished electronically. By the year 2000, it is estimated that almost all credit card transactions will be handled in this manner. Table A-21 reflects this phenomenon. The total number of bits estimated for POS terminals in 1980 is 12 trillion, 214.4 trillion in 1990, and 360 trillion in 2000.

TABLE A-21. POINT OF SALE TRAFFIC FORECAST

	YEAR		
	1980	1990	2000
Credit card transactions at 3% growth rate per year (billions)	50.0	67.0	90.0
Percent of transactions sent electronically	6.0	80.0	100.0
Transactions per year sent electronically (billions)	3.0	53.6	90.0
Messages per year at 4 messages per transaction (billions)	12.0	214.4	360.0
Bits per year at 1000 bits per message (terabits)	12.0	214.4	360.0

A.3.4.2 Videotex/Teletext

Electronic text systems are still in their infancy, yet common requirements and distinguishing characteristics of such systems have already been identified. This attempt to define electronic text systems has helped reduce some of the confusion caused by the proliferation of generic terms and brand names used to describe electronic text systems.

All electronic text systems, regardless of their individual names or technical features, display textual information on a video display screen. All of these systems require at least two components: a computerized data base to store information and a transmission system that links the data base to the people who want information from it. The data base can contain words, numbers, or graphic illustrations, while the transmission system can range from a common telephone line to a satellite. These systems are being developed and are intended to be used primarily by the consumer in his home or business.

Two of the major factors which distinguish one system from another, from the customer's point of view, are the amount of information that can be retrieved easily from the data base and the ability to add information to the data base. Some systems are like a telephone, in that they have a two-way capacity which allows them to function as electronic mailboxes or bulletin boards. Customers can use them to bank, shop, send a letter to a friend or advertise the sale of a used car. Other systems are more like a cross between a book and TV: they are strictly one-way and the customer can receive information from the data base, but cannot transmit or add information to the data base.

Videotex is a synonym for electronic text and an umbrella term that includes teletext and Viewdata. Teletext refers to an electronic text system that usually relies on broadcast frequencies to transmit information. Like television itself, teletext systems could use a full broadcast channel; but since spectrum space is scarce, most teletext systems rely on what is called the vertical blanking interval, an otherwise unused portion of the television signal, or they rely on a single cable channel. Teletext flashes "pages" of text, one after another, in a cycle that is repeated continuously. The user punches a code into his modified TV set and the requested information is pulled out the next time it is

transmitted. The teletext data base is updated frequently and includes news, sports, weather and the like.

Viewdata systems offer customers access to a library of information and allows them to dial up information such as a sports score, restaurant review or airline schedule. Because viewdata uses a technical design different from teletext, its customers can retrieve information more quickly and from a much larger data base. Also, it is not limited to broadcast or one-channel transmission; it can operate via telephone lines or two-way cable systems. This interactive feature makes possible services like home banking, tele-shopping and advertising.

The basic teletext system works as follows:

a. The information, consisting of alphanumeric or graphic images, is encoded in a bit stream of digital data at a transmission rate that the television system can properly handle.
b. The encoded digital data is inserted or multiplexed onto the TV signal in such a way that it is located on unused lines in the vertical blanking interval.
c. The teletext signal can be detected by a special decoder that is either a separate accessory to the TV receiver or is actually built into it. In either case, the teletext decoder circuitry can accept the digital data, store one or more pages in a buffer memory, and display these pages on the screen as directed.
d. When the viewer punches the number of the desired page on his control keypad, the buffer memory containing that page is kept in a "hold" condition. The page is then transferred to the TV screen via a character and graphic generator which is part of the teletext decoder circuitry. The page remains on the screen until a replacement page is transmitted, or until the viewer selects a new page.

The essential elements of a viewdata service are:

a. A large computer that can store many thousands (perhaps even millions) of pages of textual information.

b. Computer programming (software) that permits the accessing and rapid retrieval of specific items of that information.

c. Transmission lines for sending information back and forth between the customer and the computer. These lines can consist of the public telephone network, a cable television system with two-way capabilities, or special microwave facilities.

d. Display and retrieval terminals. These can be TV receivers, with decoders attached to translate digital signals into the TV display, or modified computer terminals. As with the teletext decoder, a microprocessor that can be manufactured in large quantities is essential to a reasonable price. When used with phone lines, the terminal must contain a modem that converts an analog telephone signal into digital form for display. The retrieval device may be a simple calculator-like keypad with buttons for numbers 1 through 10, or a full typewriter-like unit.

A.3.4.2.1 Baseline

Videotex systems are still at the level of technical and market trials in the United States. The basic technologies are still evolving, so potential applications are still taking shape. Consequently, the volume of traffic consists primarily of traffic generated in market trials and a few commercial offerings.

The major contenders for the videotex market who are already conducting tests include the service providers, system operators, transmitters, and home terminal manufacturers. From 1980 to 1981 some 30 application trials of teletext and videotex were conducted in the United States. Even though there are no profits as yet, and sales are still miniscule, a wide variety of U.S. companies are already investing nearly $100 million in developing and testing videotex systems. On a worldwide basis, it has been estimated that some eighty-three experiments are now going on, with the total investment amounting to a quarter of a billion dollars.

The number of users, the amount of usage per week, and the time of usage will differ for business and home users. The ratio of business to home users is

estimated at 2:1 for 1982, 1:1 by 1990 and 1:2 by year 2000. Average business usage per week will start very low (at about 10 minutes per week) and will grow to 5 or 6 hours per week. Home usage will also start low (at about 10 minutes per week) and will grow to 1 or 2 hours per week. Considering times of usage, it was estimated that about 75% of the total usage (business plus home) will occur from 9 a.m. to noon and 1 p.m. to 5 p.m.; the peak time will occur at about 2 p.m.

The total users (home and business) presently involved in a videotex testing system or receiving commercial service number about 75,000. An estimate of traffic is based on the following assumptions:

a. 75,000 users.
b. 10 minutes of use per week per user for 52 weeks of the year.
c. 2 pages per minute.
d. 700 characters per page.
e. 8 bits per character = 5.424×10^6 bits.

Total estimated traffic is .44 terabits per year. About 10%, or .044 terabits, is estimated to be long haul (more than 100 miles) traffic.

The future volume of traffic generated by videotex systems is difficult to forecast for the following reasons:

a. The technologies supporting videotex systems are still undergoing significant changes.
b. The videotex product is still not well defined; which applications will be included is not clear.
c. There are many unanswered questions relating to spectrum allocation, standards, licensing and regulation.
d. The roles of the various providers are not well defined.
e. It is uncertain how quickly consumers will accept videotex as a way of communicating.
f. It is unclear how much consumers will be willing to pay.
g. Which applications will provide the driving force for the spread of videotex is unclear.

h. It is difficult to estimate how videotex will compete for time and money with other electronic products.

However, there are several events and trends which suggest that the videotex market could become quite large. A wide variety of United States companies are already investing heavily in developing and testing videotex systems. Telephone companies, broadcasters, cable TV operators, publishers, retailers, banks, and equipment manufacturers all are increasing their videotex efforts.

AT&T has endorsed videotex, telling its competitors and customers that it would design its own system, while more and more two-way cable TV systems are being built.

United States businessmen have been spending at an accelerating rate over the past decade to obtain electronically stored information. The general public is also becoming more receptive to electronic systems and therefore more willing to pay for transaction processing and financial services.

Based on interviews with providers and on a wide variety of articles and reports discussing videotex sytems, the total volume of future traffic generated by these systems is expected to increase from the current .44 terabits per year to 1,835 terabits in 1990 and 6,115 terabits in 2000. It is expected that about 10% of the traffic will be long haul: 184 terabits in 1990 and 612 terabits in 2000 (see Table A-22).

These growth rates are based on the following assumptions:

a. Estimated users: 15 million in 1990; 50 million in 2000.
b. Average minutes of usage per week per user: 210 minutes in 1990; 210 minutes in 2000.
c. 11,200 bits per minute, based on two 700-character pages per minute (with 8 bits per character).

TABLE A-22. VIDEOTEX/TELETEXT TRAFFIC FORECAST
(terabits)

YEAR		
1980	1990	2000
.44	1835	6115

A.3.4.3 Telemonitoring

Telemonitoring is a term used to describe electronic monitoring from a central location of the status or condition of a device at a remote and usually unoccupied location.

Generally, telemonitoring falls into one of the following categories:

1. Security
2. Civil defense and government agencies that protect citizens
3. Utilities
4. Communications systems
5. Traffic control.

Security

Most burglar and fire alarm systems that presently use telemonitoring are provided by professional alarm installers. Most systems are simple fire/smoke alarms or entry switches that are triggered when an alarm condition occurs. A wire pair is connected to an alarm panel at a central monitoring location, generally the local police station. The cost is high. In the future, 40% of the nation's businesses and 98% of future cable TV (CATV) customers may be offered a low-cost means of protecting their property. Where interactive cable is available, the communications link to a central monitoring station is already in place. The alarm industry, naturally, is trying to keep CATV from providing this service, but it would be a simple matter for the security system operators to lease a communications link from the cable company.

The concept of CATV telemonitoring is that of a high-speed head-end computer which constantly polls all households connected to the system. Each household has a unique address. Each household responds with an "okay" status by means of a modem. If an alarm condition exists, the household modem then alerts the computer of the type of alarm: fire, illegal entry or emergency. At the central station, the computer receiving the alarm prints out the name and address of the household. The attendant then notifies the proper authorities.

CATV industry sources project a tremendous growth in demand for their services on the order of some 38 million subscribers by the year 2000 (see Table A-23). Some industry spokesmen believe it is even feasible to establish "super monitoring stations" in various locations to handle from one to ten or more states. Others maintain that security controls (see Figure A-1) are best handled by local monitoring stations where police, fire and emergency crews can respond on very short notice.

Civil Defense and Government Agencies

Nuclear explosion detectors operate in the following manner. Light waves strike the detector and give it time to respond with a "Red Alarm" before the nuclear shock waves arrive to destroy the device. The detectors are mounted in a circular fashion around a major target area; each has a completely different circuit route. Thus, if a direct hit occurs on one site, the other two sensors would be able to respond. (This system may no longer be in service -- classified information.)

Government agencies operate many types of monitoring devices. EPA's air pollution monitors are one example. There are more than 8,000 air pollution monitors located throughout the United States. About 10% of those are remotely monitored at present. Budget restrictions will probably necessitate 100% remote monitoring within the next few years.

Remote monitoring devices detect flood stages on rivers, earthquake tremors and other natural threats to life and property. No figures are available on these types of monitoring. On a more routine basis, remote weather monitors transmit barometric pressure, temperature readings and storm activity data for weather forecasters across the nation. (See also Traffic Control).

Utilities

The technology behind CATV security services also supports meter reading devices to monitor gas, electric and water usage. Reduced labor and transportation costs will certainly make this capability attractive to utility suppliers. In

TABLE A-23
PROJECTED GROWTH IN CABLE SERVICE SUBSCRIPTIONS

	1980		1990		2000	
TV Households (TVHH)	80,700,000	(2)	95,000,000	(3)	100,000	(4)
CABLE TV (CATV)	18,672,000	(2)	58,900,000	(2)	90,200,000	(5)
PERCENT TVHH WITH CABLE	24%	(2)	62%	(2)	82%	(5)
NUMBER OF TVHH WITH SECURITY SYSTEMS (1)	12,335		7,600,000		38,500,000	
PERCENT ESTIMATED TVHH PROJECTED	.015%		5 TO 10%		30 TO 40%	

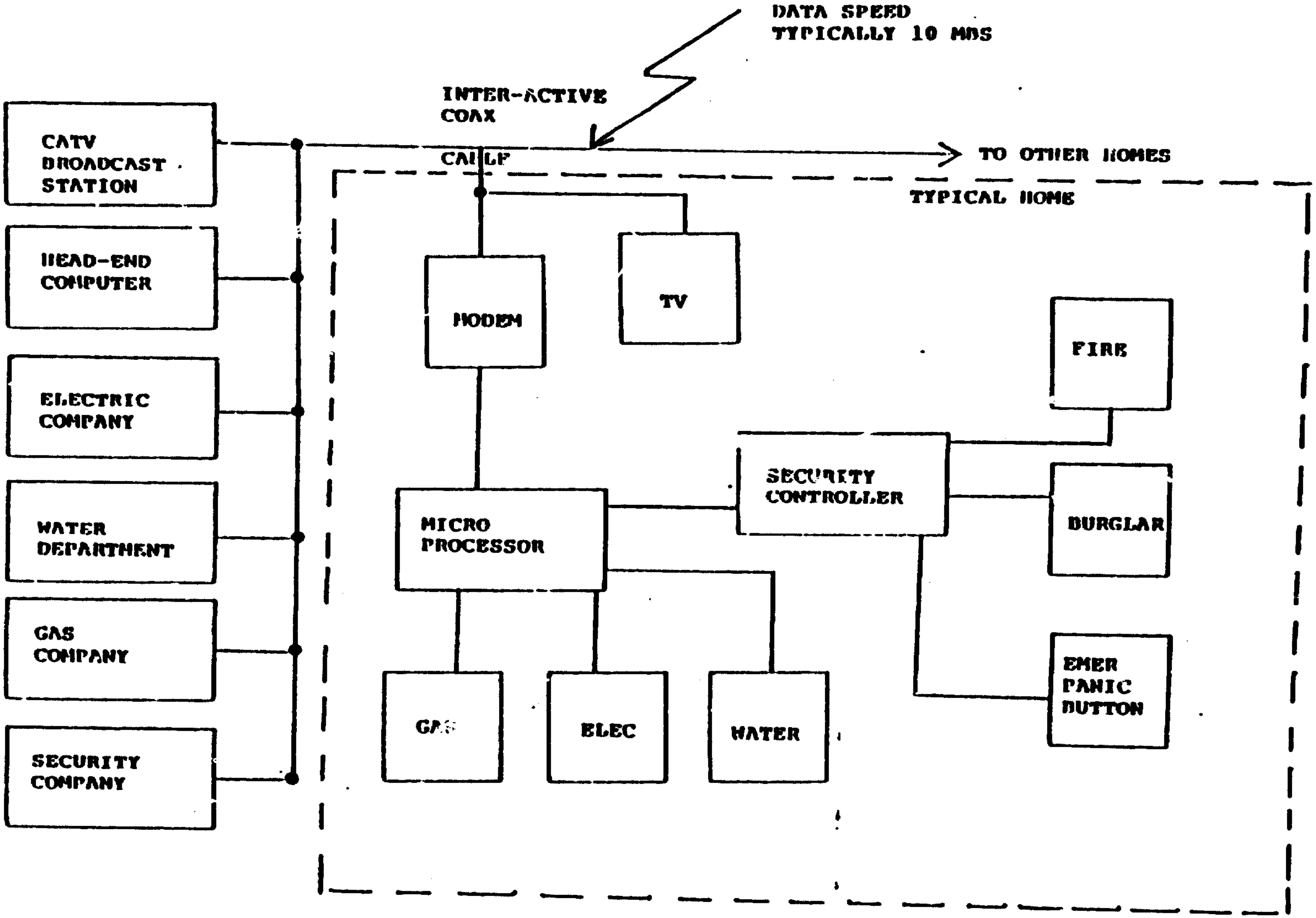

FIGURE A-1. SECURITY CONTROLS

some cases, utility information will be transmitted long distance to a state or regional office for billing purposes.

Communications Systems

Most communications systems, landline, microwave, or satellite, have built in testing which operates on a continuous basis. Remote unmanned building points, microwave stations or satellites have constant performance monitoring from a central office. Growth in this area is directly proportional to the overall growth projected in communications.

The TV industry is very concerned about viewing trends, as witnessed by the dependence on the Nielson Ratings. Thus, they could profit from the ability to build into their systems the means to determine what channel each subscriber is watching at any given time by a remote monitoring device. Summaries of that information could then be provided to suppliers of their programming.

Traffic Control

Air traffic control is perhaps the best example of a government monitoring system. All major airports have radar to monitor traffic and to radio landing and take-off instructions to pilots. Radar screens show the ground controller the flight paths of all air traffic. The flight controller advises the pilot on which altitude and direction to fly, in order to prevent collisions and promote air safety. There are approximately 20 Air Route Traffic Control Centers (ARTCCs) located throughout the United States. The ARTCCs are linked by telephone VFs to each area serviced by that control center. The sector covered by an ARTCC varies in size according to traffic density. There are seven centers along the East Coast: Nashua, New Hampshire; Ronkonkoma, New York; Leesburg, Virginia; Atlanta, Georgia; Jacksonville, Florida; and Miami, Florida. At each one, controllers are able to view airport radar sightings across their assigned territory. For example, a controller in Leesburg can remotely select a Norfolk radar scanner to obtain a visual screen of air traffic in that area.

Major changes are likely to occur in this system over the next 20 years. Clearly, the changes will involve more remote sensing of air traffic, possibly by satellite, along with further improvements in computers.

Another area of traffic control monitoring which has been proposed is the remote sensing of a vehicular accident. If all automobiles were required to have a beacon, that device could transmit an accident signal to a satellite, which in turn would notify the nearest authorities and save valuable minutes.

A.3.4.3.1 Baseline

The baseline (see Table A-24) for telemonitoring was derived based on interviews with industry sources about the different uses of telemonitoring and Western Union's own internal analysis using information such as that presented in Table A-23.

A.3.4.4 Secure Voice

Along with its many benefits, the age of electronics has provided the ability to intercept voice and data communcations for as little as several hundred dollars. Concurrent advancements in technology have facilitated electronic surveillance and interception of proprietary or sensitive information. Typical security threats include:

a. Organized and intentional attempts to obtain economic or proprietary information from the competition.

b. Determined attempts to obtain economic and sensitive information from government agencies dealing with the military and the private sector.

c. Fraud through illegal access to computer data banks, including Electronic Funds Transfer (EFT).

d. Intentional or unintentional destruction of computer data banks.

TABLE A-24. TELEMONITORING TRAFFIC FORECAST
(terabits)

YEAR		
1980	1990	2000
.1	.8	3.5

Since a significant portion of daily transactions occurs over the telephone, the replacement of telephone wires with microwave radio transmissions has created a condition in which information can be intercepted without requiring a "physical tap" on the telephone line; therefore, interception can be accomplished undetected.

Communications common carriers are the providers of a variety of telecommunications services and are operated as regulated monopolies. The lion's share of telecommunications, whether voice or data messages, is transmitted by the common carriers' systems. A typical network consists of some combination of land lines, microwave radio transmission systems (terrestrial and satellite) and undersea cables. In the United States, between 65 and 70% of all toll messages are carried by microwave radio facilities at some point along their route.

There are two basic forms of telephone service: Public Telephone Network (switched lines) and Private Line Service (dedicated lines). Dedicated private lines are always transmitted over the identical route, transmission facility and circuit. Similarly, the dedicated private line always occupies the identical segment of the radio spectrum. Therefore, once the interceptor "locates" the frequency of the dedicated circuit of interest, electronic equipment can monitor every message over that circuit.

With the dial-up network and switched private lines, the interceptor can select calls of interest, since each call is preceded by a signal identifying the telephone number being called. With the use of computers, the interceptor can easily monitor and selectively screen large volumes of messages; the computer simply searches for key words, names, subject titles and/or telephone numbers of interest. A computer can perform this task on digital data extremely rapidly.

In the case of voice communications, at least for now, technology is not well-developed enough to monitor large volumes of calls automatically except through use of the accompanying signaling information. With the recent and continuing advances in automatic speech recognition that employ word-spotting techniques, the expense of electronic interception of voice messages may be substantially reduced.

Communications security for voice and/or data messages requires the utilization of a variety of technologies depending upon specific application requirements. In voice communications there are two primary techniques:

1. scrambling of the analog voice signal, or;
2. converting the analog voice signal to digital form and then implementing any one of a variety of digital encryption techniques using standard cryptographic technology.

Voice scrambling and digital voice encryption techniques each have their own distinct characteristics.

In general, voice scramblers offer a significant "human factor" advantage, in that they can provide excellent speech quality and speaker recognition. However, this is offset by the fact that the level of security for voice scramblers is considered limited when compared with the strength of digital encryption techniques. On the other hand, digital voice encryption speech systems offer a significantly higher level of protection at the expense of speech quality and speaker recognition.

Analog scramblers modify the voice signal by changing the signal in the amplitude, time or frequency domains or any combination thereof. Typical scrambling methods include:

a. frequency inversion
b. bandsplitting
c. time division multiplexing.

There are two primary categories of voice scrambling systems:

1. Static systems allow the scrambling scheme (code) of the signal to remain constant during the course of the message transmission.

2. Dynamic systems constantly rearrange the code permutations throughout the duration of the transmission. The code could be

changed several or hundreds of times for each second of transmission time. Obviously, dynamic systems offer a higher level of protection, as they decrease ease of translation on the part of an unintended listener.

Digital voice protection systems convert the analog speech signal into an equivalent digital signal. Digital voice systems provide many advantages over analog methods in communications transmission. The significant advantage of digital voice systems is the high level of protection obtainable from a wide range of cryptographic techniques commonly used to protect data communications.

In converting the digital form back to the original analog signal, a voice synthesizer is used. Synthesis is merely an emulation of human speech by electronic means.

Once a digitized voice signal has been encrypted the level of protection is entirely dependent on th strength of the technique used to encrypt the digital voice signal.

A voice digitizer converts the analog speech signal into a digital data stream for subsequent enciphering and modulation when the terminal is transmitting, usually by:

1. Linear Predictive Coding (LPD) at the 2.4 kbps data rate
2. Adaptive Predictive Coding (APC) at a bit rate of 9.6 kbps.

Higher bit rates mean improved speech quality. Regardless of the voice digitizing function employed, the digital signal must be encrypted prior to transmission.

Cryptography is a proven, practical way to protect communication transmissions. There is a new type of analog scrambler which promises strategic protection. This device employs a technique of converting the analog signal to digital form, then applying cryptographic techniques to the digital signal with the resultant cipher text being converted back to analog form. The popular technique is to process the analog voice signals by continuously variable slope delta (CVSD)

modulation, which converts the signal to a digital data stream. The digital data is enciphered and then converted back to analog form by CVSD demodulation. The enciphered analog signal is transmitted over conventional voice-grade lines, with the reverse process occurring at the receiving end. These new hybrid devices offer a significantly higher level of protection than traditional voice scramblers, while enjoying the inherent operational advantages of analog systems.

To establish a level of protection for digital voice systems, an analysis of the various cryptographic methods available is necessary. Therefore, the relative strength of a data communications system depends on the strength of the encryption algorithm, how the algorithm was implemented into hardware, and key management.

The National Bureau of Standards has developed an encryption algorithm that has been approved by the Federal Government for certain information processing applications. The Data Encryption Standard (DES) provides protection for unclassified or proprietary information. About 50% of domestic vendors offer DES-based products.

Prospective users who may have classified or unclassified but possibly sensitive information that relates to, or borders on, national security concerns are advised to further discuss their protection requirements with the National Security Agency (NSA). NSA is the sole authority for protection of classified information which is transmitted electronically.

Presently, marketing studies show there are the following vendor-provided equipment available:

TECHNOLOGY			VENDORS	PRODUCTS
Voice Scrambler	-	Analog (VS-A)*	20	80
Voice Encryption	-	Narrowband (VE-N)	10	12
Voice Encryption	-	Wideband (VE-N)	11	22

Data Encryption (DE)**	23	71

* Includes analog FAX.
** Includes digital FAX.

Generally, the various commercial and military applications of secured voice encryption devices are installed for use in one of the following manners:

1. acoustically coupled to the telephone.
2. base station installation (radio).
3. portable (radio or telephone).
4. vehicular (mobile radio).
5. directly wired (radio or telephone).

When devices are used on typical voice-grade telephone channels, the user can expect a 3 to 5 dB loss of "signal/voice" ratio which degrades speech quality. Additionally, many communications systems, particularly telephone systems, and mobile radio telephone systems, utilize a wide variety of signals in the form of tones which are transmitted continuously, intermittently or periodically.

Communications security devices must be utilized in a way which will neither interfere with the supervisory signals nor be interfered with by supervisory signals. Proper selection of a security device is not necessarily a question of choosing the most secure technique; rather, it is a process of selecting equipment that provides an adequate level of security with satisfactorily recovered voice quality and performance over the particular types of channels with which it will be used.

Due to the privacy constraints of users of communications privacy devices, it has been difficult to determine the quantity and volume of usage of secured voice devices and systems. However, making the following assumptions a forecast (see Table A-25) was determined.

1. FCC reported 26 billion messages per year, of which 52% were "business."
2. Business messages per year were multiplied by 100,000 bits per message.

TABLE A-25. SECURED VOICE TRAFFIC FORECAST
(terabits)

YEAR		
1981	1990	2000
5.2	157	894

3. It was estimated that .4% of the messages were encrypted.
4. The growth of encrypted messages to 1990 and 2000 was postulated.

A.3.5 Summary of Data Baseline Forecasts

A summary of the baseline forecasts for the specific data services and for all data services is presented in Table A-26. The corresponding growth rates for the 1980-1990 and 1990-2000 time periods are noted in Table A-27.

A.4 VIDEO APPLICATIONS

Video applications are divided into two sections, broadcast and limited broadcast. Broadcast services are transmitted to a large number of end users simultaneously. Limited broadcast is more directly aimed even though the number of users may still be quite large, as in the case of DBS. Video services are grouped below:

1. Broadcast
   a. Network Video
   b. CATV Video
   c. Occasional Video
   d. Recording Channel
2. Limited Broadcast
   a. Teleconferencing
   b. DBS/HDTV

The first set of services deals with broadcast applications. The steps used to establish the baseline for these services are as follows:

a. Determine the number of transponders used for commercial video, PBS, educational and occasional video.
b. Determine future plans for each of the services and project onward.

TABLE A-26. DATA BASELINE

(TERABITS)

SERVICE	YEAR 1980	1990	2000
Data Transfer	464.0	1400.0	6240.0
Batch Processing	304.0	912.0	1640.0
Data Entry	380.0	1960.0	7320.0
Remote Job Entry	165.0	1295.0	2320.0
Inquiry/Response	165.0	1295.0	3088.0
Timesharing	94.0	268.0	520.0
USPS/EMSS	0	338.4	996.8
Mailbox	.2	4.9	12.7
Administrative Traffic	48.5	300.0	933.0
Facsimile	235.5	543.7	1230.0
Communicating Word Processors	17.1	117.1	400.3
TWX/Telex	1.2	1.6	2.2
Mailgram/Telegram/ Money Orders	.4	.8	1.6
Point of Sale	12.0	214.4	360.0
Videotex/Teletext	.1	275.0	917.0
Telemonitoring Service	.1	.8	3.5
Secure Voice	5.2	157.0	894.0
TOTAL	1892.3	9083.7	26879.1

TABLE A-27. DATA BASELINE - GROWTH RATES (ANNUAL, %)

SERVICE	TIME PERIOD 1980-1990	1990-2000
Data Transfer	11.7	16.1
Batch Processing	11.6	6.0
Data Entry	28.1	14.1
Remote Job Entry	22.9	6.0
Inquiry/Response	22.9	9.1
Timesharing	11.0	6.9
USPS/EMSS	0.0	11.4
Mailbox	37.7	10.0
Administrative Traffic	19.6	12.1
Fascimile	7.5	8.5
Communicating Word Processors	21.2	13.1
TWX/Telex	2.9	3.2
Mailgram/Telegram/Money Orders	4.8	7.2
Videotex/Teletext	120.8	12.8
Telemonitoring Service	23.1	15.9
Secure Voice	40.6	19.0

This technique will give the net addressable satellite forecast which must then consider any potential impact factors.

To understand how each transponder is currently being used, FCC reports were reviewed to determine those satellites currently in use. To ascertain the future growth of network video three sources were used. First, all announced plans for future transponder use in trade magazines as well as new filings for satellite systems were reviewed. Second, the future of satellite transmission was discussed with industry representatives from CBS, PSSC and others. Third, the future of the industry was discussed internally with our experts. Western Union has prepared bids for both NBC and PBS on satellite use and is currently doing the distribution for PBS. Most of the WESTAR System is used either for cable or occasional television distribution.

For the other two services, teleconferencing and DBS/HDTV, a forecast was made only for teleconferencing. This was done using a vendor survey as well as industry studies. DBS/HDTV was treated as an impacting factor only since the FCC is likely to allocate use of spectrum outside those considered by this study.

A.4.1 Broadcast Services

The greatest use of satellites so far, outside of voice, has been with video applications. The reasons for this are the wide bandwidth required for video transmission and the need to reach a large number of locations throughout the United States. Western Union's initial study broke the video market down into three segments: network video, CATV distribution, and occasional video used by both the networks and CATV. Two new entrants have appeared recently which promise to add to the video explosion. They are direct broadcast services (DBS) and high definition television (HDTV). A brief description of each of these services is given before explaining the forecasting techniques used.

A.4.1.1 Network Video

Network video has traditionally used dedicated full time facilities for point to multipoint distribution. Since the introduction of satellites, the networks are doing more multipoint to multipoint distribution. For instance, ABC's Good

Morning America show originates in New York, the news spot is done from Washington, and the weather from Atlanta as well as feeds from throughout the U.S. for other portions of the show. Besides commercial television, other applications fall under network video and are prime candidates for satellite transmission, including Public Broadcasting Service (PBS) and the Educational Networks.

The commercial networks, ABC, CBS and NBC, offer free programming paid for via advertising. Currently, almost all regular broadcasting for the commercial networks is carried to affiliated stations via AT&T long lines microwave networks. However, recently all three networks have signed agreements with AT&T to begin satellite transmission of programming to affiliated stations. From that point, it is retransmitted or aired to the local community. PBS, on the other hand, operates by fund raisers, company donations and some government support (although it has applied to the FCC for permission to allow advertising). PBS also uses affiliated stations to rebroadcast; however, it uses satellites to distribute the information to those stations. Educational networks, funded largely by states, local governments and universities to provide classroom instruction to large audiences, have grown rapidly in the last decade. Although most of this is fairly local, it is likely that as networks join together to provide better training at less cost satellite distribution to local stations will grow. Three states, Indiana, Florida and Michigan, already use satellite transmission to meet their statewide educational goals.

A.4.1.2 CATV Video

CATV video comprises program originators other than networks, who video broadcast their programs on a part-time regional or national basis. Distribution networks usually include terrestrial (cable), microwave and satellite facilities. In the case of satellite distribution, affiliated small earth stations interconnect the space segment (leased by the distributor) and the cable head end.

As CATV continues to grow, the need for programming also will continue to grow. This demand is already seen in the fierce competition to gain transponder access. According to industry sources, cable is already connected to 25% of American households. Most large urban areas have not even been wired yet.

Areas such as Chicago and Dallas are very near and will add to the demand for programming. Thanks to cable, the market will continue to be segmented, with religious stations, black stations, public affairs stations and so on. Although this demand for programming will someday be saturated, this is not likely to occur until after 1990.

A.4.1.3 Occasional Video

Occasional video refers to event broadcasting such as news, sports events or movies. A large number of programmers use this type of transmission including the networks and various cable stations.

A number of companies, such as Wold or Satellite Syndicated Systems, offer this type of service for a few hours at a time, using remote hookups much of the time. Other uses for occasional video are continually being thought of. One example is horse racing. In Connecticut, a highly successful theater was built in 1979 which broadcasts live horse races. This idea has been picked up by entrepreneurs in Las Vegas who plan to broadcast these races live.

A.4.1.4 Recording Channel

Recently, CBS announced plans for a video recording channel. Material suitable for programming is transmitted to the home via cable during low usage hours (after 1:00 A.M.). The growth of video recorders and the desire for uninterrupted programming that can be recorded along with the lower cost associated with these hours makes this a desirable offering. Since transmission of this service occurs during off hours, we have not projected any transponder use for 1990. By the year 2000 one can expect that some recording channels will be offered during peak times or even 24 hours, based on the anticipated growth of video recorders.

A.4.1.4.1 Baseline

The method used in the previous study to establish the baseline forecast for this service was not used; that study determined the total amount of network traffic. It was decided that although nothing was wrong with this approach, a more

 C - 2

accurate technique would be to ascertain the actual number of transponders in use and their future growth rate. The steps used to establish the baseline are as follows:

a. Determine the number of transponders used for commercial video, PBS, educational and occasional video.
b. Determine future plans for each of the services and project onward.

This technique will give the net addressable satellite forecast, which must then consider any impact factors.

To determine how each transponder is being used, we went to the FCC and reviewed those satellites currently in use. To ascertain the future growth of network video three sources were used. First, all announced plans for future transponder use in trade magazines as well as new filings for satellite systems were reviewed[24,25,26,27,28,29]. Second, the future of satellite transmission was discussed with industry representatives from CBS, PSSC and others. Third, the future of the industry was discussed internally with Western Union staff. Western Union has prepared bids for both NBC and PBS on satellite use and are currently doing the distribution for PBS. Most of the WESTAR System is used either for cable or occasional distribution.

Compression of video signals is likely to occur in the early 1990s. This will not be accepted by everyone because of the high quality picture required. Other trends such as multilingual sound, stereo sound and high definition sound will also work against compression. Therefore, a factor of 1.5:1 was applied to calculate the expected number of transponders required. See Table A-28 for the 1980, 1990, and 2000 Broadcast Services forecasts.

A.4.2 Limited Broadcast

Broadcasting is meant to cover a very broad area; limited broadcasting is more directed. Two services are covered under limited broadcasting, teleconferencing and direct broadcast satellites/high definition television (DBS/HDTV). Teleconferencing is usually conceived as a meeting between two or more groups.

DBS/HDTV is similar to broadcast TV although it is picked up by a rooftop antenna.

A.4.2.1 Video-Teleconferencing

Video-Teleconferencing is expected to be the driving force behind transponder demand from 1985 through the end of this century[24,25]. The basic purpose of video-teleconferencing is moving meetings to people, rather than people to meetings.

There are many variations of video-teleconferencing from fixed frame one-way video/two way audic, requiring simple phone lines, to high definition two-way video and audio, requiring a very large bandwidth. The number of sites involved may vary from two to dozens.

Video-Teleconferencing is just now entering its growth phase. A number of companies, including ARCO, MACOM and many others, have installed their own facilities to conduct video-teleconferences. Users report improved efficiency and increased cost effectiveness. As travel costs continue to rise and the cost of teleconferencing facilities declines, word of the success of video-teleconferences will inspire others to jump in.

Hotel chains are an example of this trend. Many major chains have established a network to handle video-teleconferences. They include:

Holiday Inn	Hyatt
Raddisson	Marriott
Hilton	

Besides the hotel industry, a large number of private companies now provide this service, including AT&T and SBS, and are pushing hard to expand their markets.

The three video-teleconferencing arrangements analyzed include:

a. Full motion
b. Limited motion
c. Fixed frame

TABLE A-28. BROADCAST SERVICES FORECAST
(36 MHz transponders)

	YEAR		
	1980	1990	2000*
Network			
Commercial	5	30	27
PBS	4	7	6
Educational	1	5	7
	9	42	40
CATV	34	76	57
Occasional	19	52	41
Recording Channel	0	0	2

* A compression factor of 1.5:1 was used in 2000.

Full Motion Video-Teleconferencing provides the most realistic conference atmosphere. It is, therefore, the most popular form of video-teleconferencing. It normally uses 22MHz of bandwidth and is often used in conjunction with high speed facsimile or another data link. Digital technology is the most likely form of transmission and a 2:1 compression ratio can be expected by 1985.

Limited Motion Video-Teleconferencing transmits a picture much as full motion does; however, gaps are apparent as the equipment waits for the next transmission. This type of conferencing is useful where one person does much of the presentation. Limited motion video conferencing can be done using 1.5, 3.1 or 6.3 Mbps facilities. Better motion, color and details occur at the higher transmission rates. Western Union engineering analysis indicates that approximately 12 limited motion conferences could be held per transponder.

Slow Motion Video-Teleconferencing is very useful where diagrams or charts are being presented and then discussed. This technique is useful with engineering drawings and shows promise for telemedicine. Although this type of conference can use between 1.2 kbps and 1.5 Mbps, it was assumed that the average conference uses 56 kbps. Using this average along with internal engineering analysis it was determined that an equivalent 50 Mbps transponder could handle 300 one way video conferences.

A.4.2.1.1 Baseline

In order to determine the demand for video conferencing, a number of steps were taken. The major ad hoc vendors (such as Tymnet and PSSC) were contacted and the following questions were asked:

1. In the last year, how many teleconferences has your organization done?
2. Were these conferences full, limited, or fixed frame?
3. Was the conference one-way video/two-way audio or two-way video/two-way audio?
4. On the average, how many sites were involved?
5. Over what distance was the conference usually held?

6. What was the typical length of the conference?
7. Was there a particular time of the day when conferences seemed to be held?
8. What type of growth do you feel will occur in teleconferencing in the next five years?
9. What are the prospects after that?
10. Do you have any other comments you would care to make?

The information from the vendor survey was weighted carefully considering the audience contacted. The survey included vendors providing large conferences, with the average size of a conference covering 15-20 sites. Most of these conferences were one-way video/multi-way audio and lasted two to three hours. Because of the large geographical areas covered, time differences had to be considered. Therefore, conferences generally began between 10 a.m. and 8 p.m. Eastern Standard Time, with 2 p.m. being the most popular time. The following is a summary of these interviews.

> Video teleconferencing is a service that has a great potential for growth over the next few years. The possible applications are tremendous, both on an ad hoc basis for one-time conferences and in the context of a dedicated system serving the internal communication needs of a single business entity.
>
> Most teleconferencing today is full motion (rather than slow scan type) with one-way video and two-way audio hook-ups. As technology improves, becoming more familiar and less costly, we can anticipate a wider use of two-way video and audio teleconferencing.
>
> Any number of sites may be involved in a teleconference, depending greatly on the needs of a particular customer and the purpose to be served. The number of sites ranges from one to hundreds on a national and/or international scale. The average seems to be in the 15 to 25-site range, making a teleconference an economically feasible alternative to travel.
>
> As a rule, a teleconference links a widely disparate geographical area which usually includes both east and west coasts. There is some tendency to cluster in large population areas along the west coast or the northeast corridor of the U.S. Teleconferencing can be useful in linking various regions, but is not often a factor within a very regional framework due to cost factors.

Most teleconferences last about two to three hours, although this is another factor which varies widely according to need. Typically, the actual time devoted to teleconferencing is padded somewhat by time spent in educating the participants in the most effective methods for using a relatively new service.

Given the geographical range of areas covered and differing time zones nationally and internationally, timing becomes a factor in planning which cannot be ignored. Teleconferencing between east and west coasts tends to center between 10:00 A.M. and 2:00 P.M. in order to compensate for time differences and to keep the teleconference within business hours. This problem grows more acute as the teleconference takes on an international rather than a purely national aspect.

Another limitation to be considered is the availability of transponder time to the organizations arranging teleconferencing. Limited transponder availability also dictates to what extent a customer may choose the day and time of the proposed teleconference. A fully dedicated system or continuous access to transponder use obviously makes teleconferencing a more flexible tool enjoyed by relatively few users at the present time. There are expected to be substantially more transponders available by 1985 (and/or transponders with greater capacity) which should alleviate the problem of transponder time. That should, in turn, make teleconferencing a more economically sound, less costly service, thereby opening up the market for ad hoc use of teleconferencing to smaller concerns who could not presently afford it.

One scenario for the growth of teleconferencing sees an explosive growth rate in ad hoc use of teleconferencing over the next couple of years (as much as 100% per year for 5 years) gradually tapering off. As familiarity increases and technology improves, teleconferencing will become a business necessity for large nationwide users, resulting in a less dramatic, though steadily increasing (25%) and continued growth rate as more dedicated systems are implemented. Eventually, the dedicated system will be the more widely used, despite the growth spurt in ad hoc use that has developed over the past couple of years and will probably continue for the next few years.

At the moment, there seem to be about 140 teleconferences (as an average) held on a yearly basis. This figure is constantly increasing and will continue to do so. Several factors enter into the actual planning of a teleconference. There is a need to familiarize the client with the technology itself so as to put it to its most effective use and to respond to that client's real needs. The cost factor is a consideration; so is availability of transponder time: all of which suggests a preferred lead time of six months. Teleconferencing can be done, and done successfully, in much less time given the appropriate set of circumstances. It does, however, require a certain amount of preparation to be most effective. Another consideration is the

importance of social interaction. One benefit of teleconferencing is the ability to make those in more remote sites feel they are actually participating in the meeting and/or decision-making process. This sense of immediacy must be balanced against the trend of social interaction which results from informal contacts made when all conference participants are in the same location.

The AT&T and SBS filings which discuss teleconferencing were reviewed. Current literature discussing the service and its use was also reviewed as well as many of the studies performed by industry analysts. Information provided by vendors and the user survey enabled us to establish the actual number of conferences held in 1980. All sources combined were used to determine a forecast for 1990 and 2000.

After determining the forecast, the results were discussed with Western Union's product line people who are about to enter this field. The results were then modified to reflect their input and are presented below.

For the purpose of presenting the data on video-teleconferencing, teleconferences have been divided them into "public" and "private" teleconferences. Public use consists of those who provide transmission capability and teleconferencing facilities as a service to the general public. Generally, this means a one-time conference held by a private company or organization that does not have its own facilities available. One example is AT&T's new Picture Meeting Service (PMS). Private teleconferencing, therefore, consists of any dedicated or in-house system. Private companies and Government agencies fall under this definition. SBS is a leading example of a private teleconferencing system.

The current number of teleconferencing rooms was obtained through the literature search. Approximately 12 private rooms and 30 public rooms are all used on a limited basis. Future rooms were projected based on the AT&T Picture Meeting Service (PMS) tariff filing, interviews with vendors and other industry literature.

ROOMS	1980	1990	2000
Private	12	4287	13,963
Public	30	500	900

To show that the numbers are reasonable, one can take a year and look at the tariff filings. For instance, estimates from AT&T and SBS indicate that around 2,100 public rooms will be in use by 1985. Also, 4,500 private rooms are projected for 1990 using other industry sources. Discussions with CODEC (makers of compression equipment which allows you to hold a video conference at a very economical cost) indicate that as the quality of their equipment improves and the cost continues to come down, the growth rate for new rooms will increase dramatically. Average daily use is projected in hours as:

DAILY USE (hours)	1980	1990	2000
Private	5	4	3
Public	1	5	4

Initially, private rooms will be installed in heavy usage areas. Public and remote rooms include the PMS service and ad hoc meeting rooms (only rooms with uplinks are counted). As the number of private rooms grows, less heavily used rooms will be counted, thus bringing the average daily usage down. Heavy advertising, competition and the realization by many businesses that video conferencing can pay will lead to a much heavier use of public rooms by 1990. The average daily use figure will decline by 2000 because of competition and the proliferation of less heavily used rooms.

Average conference length as well as the average number of rooms per conference can be projected based on the results of surveys conducted by AT&T, SBS and Western Union.

LENGTH (hours)	1980	1990	2000
Private	3.0	2.0	2.0
Public	4.0	2.5	2.0

ROOMS (Per Conference)

Private	2.5	2.3	2.1
Public	4.0	4.0	4.0

Conferences tend to get shorter as more people become familiar with the technology and as rooms are made available for more spur-of-the-moment conferences. Public conferences tend to be longer because the topics are often broader with greater potential impact. Thus, the company sees the importance of making arrangements to hold a conference in order to include as many views as possible in its decision-making function.

It is possible to project the number of conferences by using the projected number of rooms, the length of an average conference, average daily use and the number of rooms per conference. The formula used is explained below.

Step		Procedure
find number of	start	number of conference room
conferences given	-	number of conference rooms/conference
at any one time	=	conferences (at any given time)
determine the	x	hours per day of use
number of	=	conference hours per day of use
conferences	-	conference hours/conference
per day	=	conferences per day of use
determine the		
number of con-	x	number of days of use per year
ferences per	=	conferences per year
year		

NUMBER OF CONFERENCES	1980	1990	2000
Private	2,083	932,065	2,493,452
Public	488	62,500	112,500
Total	2,571	994,565	2,605,952

Converting this value to the number of transponders required to handle the teleconferencing traffic requires some projections about the type of conference to be held. Our interviews revealed that full motion was desired by a number of organizations but the cost was prohibitive. This problem is expected to be solved by the introduction of high quality compression equipment (transmitting between 1.5 and 6.3MBPS) by the mid-1980s. Another trend our surveys showed was toward dedicated facilities. Many of these would operate both at limited and full motion video and include such things as high speed facsimile or electronic blackboards.

TYPE OF CONFERENCE	% in 1980	% in 1990	% in 2000
2 way full motion 2 way audio	30	5	1
1 way full motion 2 way audio	50	10	3
2 way limited motion 2 way audio	5	60	68
1 way limited motion 2 way audio	0	5	8
fixed frame	15	20	20

To determine the number of transponder hours required to handle traffic, multiply the total number of conferences by the percentage of each type of conference held (A) (see Table A-29). Next divide this by the total number of conferences an equivalent 50MBPS transponder can carry (B). Then divide the conferences into private and public (C). Multiply this by the average length of the conference to get transponder hours (D and E). Estimate the amount of traffic likely to go over satellite (F). This estimate is based on case studies of current systems as well as future tariff estimates and the lowering of the crossover distance. Multiplying the number of transponder hours (E) by the traffic likely to go over satellite (F) gives the number of transponders required (G). Then estimate additional compression of the video signals (H) and apply this (I). Divide this by the number of hours in the typical work year available to video conference (J). This is based on 250 work days consisting of a five hour day. Factors such as the time zone effect and reluctance to have either very early or very late business meetings were considered in selecting a five hour

work day. Peaking factors were applied in step K. An industry report cites 2.5 as the peaking factor in the 1980 to 1985 time frame. Our interviews led us to conclude this was a reasonable premise. In the future, as more sites are added and more impromptu conferences are held, this figure is likely to decline (1.2 was used in 1990 and the traffic was constant over the main 5 hours in 2000).

A.4.2.2 Direct Broadcasting Service/High-Definition Television

Direct Broadcasting Service (DBS) is the direct reception of video or audio signals from satellites to individual receiving antennas, thereby bypassing terrestrial transmission and receiving stations[26,27,28,29,30,31].

DBS provides an exceedingly flexible, distance-insensitive means of transmission with the potential of reaching geographical areas which are difficult or impossible to reach by terrestrial distribution networks. This factor is important when considering the difficulties of providing an equitable distribution of comunications services between rural and urban areas of the country.

Rural communications can be substantially enhanced by the use of direct broadcasting services which can succcessfully transmit a smorgasboard of communications services in an efficient, cost-effective manner. Special interest television, commercial and non-commercial television, information services such as teletext, store-and-forward message systems, educational and public service programming are just a few of the telecommunications services which can be provided by a direct broadcasting service.

One disadvantage of DBS that has been suggested is that it would result in a lessening of local service: one of the underlying concepts of the 1934 Communications Act was to encourage local ownership of broadcasting facilities and local programming to satisfy community needs.

Existing technology is sufficient to implement a DBS System: all indications are that DBS will become more economically feasible as the technology develops. The cost of a receiving antenna has already decreased and will continue to do so as DBS becomes a widespread reality.

TABLE A-29. VIDEO-TELECONFERENCING FORECASTS

	1980	1990	2000
A. TYPE OF CONFERENCE			
2 way full motion	771	49,728	26,059
1 way full motion	1,286	99,457	78,179
2 way limited motion	129	596,739	1,772,047
1 way limited motion	0	49,728	208,477
fixed frame	386	198,913	521,190
B. TYPE OF CONFERENCE			
2 way full motion	771	49,728	26,059
1 way full motion	643	49,728	39,090
2 way limited motion	22	99,457	295,341
1 way limited motion	0	4,144	17,373
fixed frame	2	663	1,737
C. TYPE OF CONFERENCE			
PRIVATE:			
2 way full motion	625	46,603	24,934
1 way full motion	521	46,603	37,402
2 way limited motion	18	93,191	282,591
1 way limited motion	0	3,883	16,623
fixed frame	2	623	1,662
PUBLIC:			
2 way full motion	146	3,125	1,125
1 way full motion	122	3,125	1,688
2 way limited motion	4	6,250	12,751
1 way limited motion	0	261	750
fixed frame	0	40	75

D. TRANSPONDER HOURS PER TYPE OF CONFERENCE			
PRIVATE:			
2 way full motion	1,875	93,206	49,876
1 way full motion	1,563	93,206	74,818
2 way limited motion	54	186,414	565,454
1 way limited motion	0	7,766	33,252
fixed frame	6	1,246	3,324
PUBLIC:			
2 way full motion	584	7,833	2,250
1 way full motion	488	7,833	3,376
2 way limited motion	16	15,625	25,228
1 way limited motion	0	653	1,500
fixed frame	0	100	150
E. TOTAL TRANSPONDER HOURS ALL CONFERENCES	4,586	414,380	759,206
F. PERCENT OF TRAFFIC CARRIED VIA SATELLITE	33	70	85
G. TRANSPONDER HOURS REQUIRED FOR SATELLITE TRAFFIC	1,513	290,066	645,325
H. FUTURE VIDEO COMPRESSION	1:1	2:1	3:1
I. TRANSPONDER HOURS REQUIRED CONSIDERING COMPRESSION	1,513	145.033	215,108
J. TRANSPONDER HOURS REQUIRED DURING BUSINESS DAY	6.1	580.1	860.4
K. TRANSPONDERS REQUIRED FOR PEAK HOUR	3	139	172

The "footprint" of the transmission may be either broad beam, covering a large geographical area or a spot beam, focusing in on a more specific location. The power of the transmission and the geographical area targeted determines the size of the receiving antenna, the "dish". The signal can then be retransmitted terrestrially by microwave or a similar system, although it is usually thought of as direct-to-house transmission.

The earth terminal is a major factor in direct broadcasting as it is the equipment which picks up the satellite signal, amplifies it, and remodulates it for reception on television sets. Beyond conventional television reception, direct broadcasting service could also be the transmission mode for high-definition television (HDTV).

HDTV uses a much wider bandwith for transmission of a 1,125 line system that gives a much clearer television picture on a large screen than currently seen from the 525/625 line system used in conventional television broadcasting.

Japan, several European countries, and Canada have already experimented successfully with a direct broadcasting system. In the United States, the FCC is considering deregulation of the cable industry which will have a great impact on the eventual development of DBS. There have been nine applications accepted by the FCC for permission to implement a DBS System (RCA, CBS, Western Union, Focus, STC, DBSC, Graphic, VSS and USSB) even given the high risks and high costs of first time entry into the market. Full implementation depends on economic conditions, market conditions and launch schedules over the next several years. Only 3 of the 9 proposals have indicated any preliminary launch dates, starting in late 1985/1986. At the present, we could anticipate that around 25 satellites dedicated to DBS would be operational around 1990 upon full implementation of these 9 proposals.

Comsat's DBS (STC) proposal envisions 6 satellites with four operational and two in-orbit spares, the first to be operational by 1985, marketed in areas where no cable or limited programming is available. It will be essentially a subscription TV service with three channels: one with major motion pictures, concerts, and stage productions; one with children's programming' and one with sports, adult

educational and experimental theater. The Comsat system will require a 30" antenna at a cost of around $500.00.

CBS has filed a DBS proposal to dedicate the entire DBS system to HDTV, a proposition which finds little support among DBS applicants who see it as an inefficient use of available spectrum.

HDTV requires a channel width of 27MHz and may even go to 70MHz for optimum use. The CBS HDTV proposal would transmit 1,125 line HDTV signals to and from the satellite, requiring more power and a 150MHz channel. This requirement would use a whole spectrum at 12GHz. It has been suggested that it may be compatible with the Comsat DBS (STC) proposal by compressing HDTV signals to 50MHz. Increased transmission power in this satellite range enhances the ability to receive the transmission with a relatively uncomplicated small "dish." This factor, in turn, makes individual home reception a feasible and effective use of DBS for the individual homeowner, hotel/motel manager, institutions, educational institutional, apartment building, condos, and others.

There has been little coordination in the Western Hemisphere in terms of allocating spectrum space for DBS, despite Canada's early use of a DBS System. Nor is there likely to be any decision before the 1983 World Radio Conference for Region II, North and South America. That conference will allocate spectrum for direct broadcasting service. Direct broadcasting service will transmit on Ku-band by international agreement, and will most likely be in accordance with standards set up by the 1977 WARC. There has also been an attempt to get the FCC to allocate a bandwith of the spectrum for DBS. Currently, DBS is expected to operate between 12.2 and 12.7GHz, a bandwidth allocated to fixed satellite service (FSS).

Because the eventuality of a separate frequency allocation by ITU (International Telecommunications Union) and the FCC is very likely and since the frequency is outside of that used for other satellite transmissions, there is no need to include a traffic estimate in this study. DBS will not replace TV transmission methods, but will compete by providing unique features of delivery and service, very similar to pay TV. The impact of DBS and HDTV on sevices forecasted will be determined by the effect of market determinant factors.

A.4.3 Summary of Video Baseline Forecasts

The baseline forecasts for the specific video services and for all video services are presented in Table A-30. The corresponding growth rates are indicated in Table A-31.

A.5 TRAFFIC NOT ADDRESSED

As we determined the baseline, it became obvious that large segments of traffic going through the United States' satellites may not have been counted. The strong ties between United States and Canadian business interests will certainly mean that large amounts of voice, data and video traffic will be carried between the two countries. Until recently, the only traffic between the two was carried over microwave. Video piracy of cable transmissions has altered this, though, and with introduction of DBS and a host of business services, it seems likely that the barriers to transborder communications will fall. The large Spanish-speaking population centers in the United States and the recent oil connections between the United States and Mexico mean that more information will flow that way, also.

Other traffic not considered but which may be significant is traffic to Hawaii, Alaska, and Puerto Rico. Much of this traffic will be handled on satellites viewed by the 49 continental states, and thus should be considered.

Transcontinental traffic which is international has also not been considered. Communications between Chicago and London, for instance, may very well double hop and therefore will use a domestic transponder. It is very easy to conceive of information going to South America moving through domestic transponders; for example, communications between Washington and Buenos Aires.

It is very difficult to estimate the current volume of this traffic. Each service would have to be examined and the amount of traffic determined. Since a large portion of this traffic would be long distance, it may have a significant impact on the number of transponders required in 1990 and 2000.

TABLE A-30. VIDEO BASELINE (TRANSPONDERS)

SERVICE	1980	1990	2000
	YEAR		
Network	10	42	40
CATV	34	76	57
Occasional	19	52	41
Recording Channel	0	0	2
Teleconferencing	3	139	172
TOTAL	66	309	312

TABLE A-31. VIDEO BASELINE - GROWTH RATES
(%, Annual)*

SERVICE	TIME PERIOD 1980-1990	TIME PERIOD 1990-2000
Network	15.4	0.5
CATV	8.4	2.8
Occasional (Video)	10.6	2.3
Recording Channel	0.0	0.0
Teleconferencing	46.7	2.2

*The low or negative growth rates for video services is due to expected compression.

A.6 CONFIDENCE INTERVAL

As stated in the introduction to the baseline section, it is difficult to project the baseline traffic demand out to 1990 and 2000. Even determining 1980 traffic demand is somewhat hard. Obviously, some services are easier to forecast than others. For example, message toll service has 25 years of historical information plus numerous studies by AT&T and other traffic engineers, making it fairly easy to project. Others, such as monitoring or teleconferencing services, are only in their infancy and thus are more difficult to project. This degree of difficulty can be stated as the "confidence interval" for Western Union's baseline forecast.

Confidence interval is defined for this study as the percent of variance that one could reasonably expect from the stated baseline forecast. It is stated as a percent of the baseline forecast traffic in either the plus or minus direction. Thus, for mobile radio, with a confidence interval of 5 in 1980, the traffic may be stated as 1.4 thousand half-voice circuits ±5%. The confidence level for each service for each year are presented in Table A-32.

Four factors went into determining the confidence interval assigned to each service. First, the source of the information was evaluated. If the information came from the FCC or other government statistics, it was considered the best information available. Industry and user sources were considered the next most reliable, followed by internal Western Union studies and finally by independent analysis by research groups were also important resources. All sources were found to be valuable, but a ranking was necessary to estimate confidence intervals. Second, the logic of the projection technique was considered. In other words, did factors fit together and flow logically from the source of the projection to the traffic numbers or were a number of assumptions made. The third factor was the consistency and the number of other reports we were able to compare our estimates with. Often we found several reports on the same service using different techniques and arriving at different results. The fourth and final factor was an internal critique by Western Union's Marketing Research Department, its Product Line Managers, Traffic Engineers, and others.

Determining the confidence level not only shows the level of difficulty in making individual service projections, but also reflects the overall confidence one can

TABLE A-32. CONFIDENCE LEVELS

VOICE	1980	1990	2000
MTS (Business)	2	7	12
MTS (Residential)	3	8	13
Private Line	5	10	15
Mobile	2	7	12
Public Radio	2	7	12
Commercial and Religious Radio	5	10	15
Occasional Radio	5	10	20
CATV Music	2	7	15
Recording Channel	0	0	50

DATA	1980	1990	2000
Data Transfer	10	20	25
Batch Processing	10	20	25
Data Entry	10	20	25
Remote Job	10	20	25
Inquiry/Response	10	20	25
Timesharing	10	20	25
USPS/EMSS	0	10	15
Mailbox	5	15	20
Administrative Messages	5	10	20
Facsimile	8	15	20
Communicating Word Processors	5	10	15
TWX/Telex	2	7	12
Mailgram/Telegram/Money Orders	2	7	12
Point of Sale	15	25	40
Monitoring Service	15	25	50
Videotex/Teletext	5	20	30

TABLE A-32. CONFIDENCE LEVELS CONTINUED

VIDEO	1980	1990	2000
Network	1	5	10
CATV	2	6	10
Occasional	3	8	13
Recording Channel	0	0	50
Teleconferencing	2	10	20

have in the overall baseline forecast. This can be done by first multiplying the confidence interval times the percent of traffic each service has in terms of voice, video and data. Since it is difficult to put everything into common units at this point, the best way to get an idea of the overall confidence level of the baseline forecast is to weigh the overall confidence interval for voice, video and data by their respective percentages in Western Union's last report (reference 8).

Another advantage of using confidence levels is the ease of determining an upper and a lower bound for the expected traffic. This is done by weighting each service by the confidence level, then adding them to produce the ranges for voice, video and data.

In no case should the confidence level be confused with the market determinant factors. Confidence level only reflects the difficulty of forecasting, while market determinant factors are future events which will impact individual services.

A.7 SUMMARY OF BASELINE FORECASTS

A summary of the baseline forecasts for voice, data and video and of the corresponding growth rates from 1980 to 2000 is presented in Table A-33.

TABLE A-33. SUMMARY CHARTS

FORECAST	YEAR 1980	1990	2000
SERVICE			
Voice (10^3 half-voice circuits)	2828.9	8045.3	18405.3
Data (terabits)	1892.3	9083.7	26879.1
Video (transponders)	66	307	312

GROWTH RATE, (Annual, %)	TIME PERIOD 1980-1990	1990-2000	1980-2000
SERVICE			
Voice	11.0	8.6	9.8
Data	17.0	11.5	14.2
Video	16.7	.1	8.1

A.8 REFERENCES

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APPENDIX B

IMPACTED BASELINE FORECASTS

B.1 INTRODUCTION

The impacted baseline forecasts were developed by refining the baseline forecasts. As noted earlier, the baseline forecasts for each service were projections of the current and future volume of traffic. The baseline forecasts were scenarios reflecting the occurrence of expected events and orderly growth and the results of a cross impact analysis which eliminated duplicate demand. The impacted baseline forecasts were made by considering the impact of less predictable events or market determinant factors on the baseline forecasts.

B.2 THE IMPACTED BASELINE MODEL

The Western Union impacted baseline model is designed to refine, update and adjust forecasts. The following can be changed at any time:

a. The number of MDFs or services
b. The event probabilities
c. The cross-impact of the events
d. The impact of the events on the services

Two techniques for calculating the impacted baseline forecasts are built into the model:

a. The multiplication method--impacts of an event on events or an event on services for a particular year are calculated by multiplying the event's probability for that year by its total impact. The event is treated as if it partially occurred.
b. The random-all-or-none method--the event's probability and a random number generator are used to determine whether or not the event occurs in a particular year. The event is treated as occurring completely or not at all and its impacts are treated accordingly. The multiplication method approximates the

average of all possible scenarios developed by the random method.

For this report, the multiplication method was employed and its use is reflected in the analysis discussed below. However, the random-all-or-none method can be employed at any time to examine the variety of scenarios possible. Either method can be employed to conduct sensitivity analyses. Most importantly, the model can be employed to develop a variety of scenarios which can be used in strategic and long-range planning.

B.3 MARKET DETERMINANT FACTORS (EVENTS)

A Market Determinant Factor (MDF) or event was selected if it had the potential to impact the long haul market, significantly, uniquely and somewhat unexpectedly by 2000. In addition to these criteria, the matrix in Table B-1, a review of current literature and interviews with experts guided the selection of MDFs.

The matrix in Table B-1 indicates the event or MDF classes and the different impact areas for each MDF. The event classes were technological, economic and social-political and the impact areas were cost, availability, ease of use and need. An event could impact cost by making the cost of a service go down or the cost of a competing means go up; it could impact availability by making it possible to provide more of a service or to provide the service to more people; it could impact ease of use by making a service easier to use or by making a service more acceptable; and it could impact need by creating either a greater need for an existing service or a new need for the service. As a pool of MDFs was generated, effort was made to make certain that each event class was well represented and that each potential event might have at least one of the eight different impacts.

Through a comprehensive literature review and interviews with key providers, users and consultants, 36 events were identified. These events are defined briefly in Table B-2. The list of events should be considered representative of potential MDFs and should not be considered inclusive.

B.4 COLLECTION OF DATA

In-person interviews (15) were conducted with representatives of major carriers, providers, users, consulting groups, Federal agencies and Western Union Personnel to obtain information on the probability, timing and impact of each MDF. Interviewees were asked to estimate when (i.e., the year) each event would have a 10 percent or slim chance, a 50/50 chance, and an almost certain or 100% chance of occurring. They were also asked to indicate their level of confidence in making their estimates. The data collection form used to record this information on probability of occurrences of the MDFs appears in Table B-3.

Interviewees were then asked to estimate the potential impact of each of these events on the 31 specific voice, data and video services. They were also asked to note, if possible, what the event would impact: cost, availability, ease of use or need. As with the information on probabilities, interviewees were asked to indicate the level of confidence in making their estimates of impact. The data collection form used to record this information appears in Table B-4.

In addition to data on probability, timing and impact of MDFs, Western Union personnel estimated the cross-impact of the MDFs to provide a measure of the interaction of the various events. The data collection form used for this purpose appears in Table B-5.

B.5 ANALYSIS OF DATA

The first steps of data analysis involved calculating the probability of occurrence of each event for each year from 1980 through 2000. The mean year of occurrence of each event was determined for 10% chance, 50/50 chance and 100%/certain chance. The results of this analysis appear in Table B-6. Twenty-eight of the 36 events were judged to have a nearly certain chance of occurring by the year 2000. Biochips was the event least likely to occur by the year 2000, while voice-store-and-forward and a communications business shake down were the most likely to occur by 2000. Using straight line interpolation up to the year when the event chance was 100 percent, these results were transformed to provide the probability of occurrence of each event for each year from the year of 10 percent chance through the year of 100 percent chance. Then the

probabilities for each event were normalized. The normalized probabilities.for each event for the 1980-2000 time period appear in Table B-7.

Next, the effects of the event cross-impacts (i.e., the impacts of events on each other's probabilities of occurrence) were calculated. The 1 to 3 cross-impact ratings appear in Table B-8. The most influential events, in terms of their impacts on other events, were the events involving advanced computer technology, prosperity-depression, national resources and attitudes about technology. Also, the technology-transmission events tended to impact one another as did the economic events. The 1 to 3 cross-impact ratings were converted to 0 to 2 cross-impact scores using the scale on the cross impact data collection form. Then the normalized event probabilities were converted to odds using the following formula:

$$\text{Odds} = \frac{\text{Probability}}{(1\text{-Probability})} = \frac{\text{\# Times expected to occur}}{\text{\# Times expected not to occur}}$$

The odds for an event for a particular year were then multiplied by the cross-impact score of a second impacting event, giving the new odds for the first event. The new odds were then converted back to a probability using the following formula:

$$\text{Probability} = \frac{\text{Odds}}{(1 + \text{Odds})}$$

The difference between the old and new probabilities was the total amount of impact made by the second event on the first. To get the amount of impact for each year, the normalized probability for the second event for each year was multiplied times the difference in probability of the first event. These steps were repeated for all events and for all years. The sum of the impacts on an event's probability for a particular year was then added to the event's probability for that year. This step was repeated for all years and the probabilities for an event were again normalized. These modified normalized probabilities appear in Table B-9. The difference between the probabiliies in Table B-7 and Table B-9 reflect the cross-impacts of the MDFs. In general, a consideration of these impacts increased the probabilities of the various events.

The next major step involved calculating the impacts of the events on .the individual services. The mean impacts of events on services were calculated, and the Western Union personnel reviewed and modified these results so they would reflect considerations made when developing the baseline forecasts. The results of the modified impacts appear in the MDF-by-Service Matrix in Table B-10.

Then these impacts and the modified normalized event probabilities were used to determine the impacted baseline forecast for each service for each year from 1980 through 2000. For a particular service for a particular year, the probability of each MDF was multiplied times its impact on the particular service, and the sum of these impacts were added to the baseline forecast for the particular service. These steps were repeated for each year and for each service.

The data on confidence of estimates and on the type of impact (e.g., on cost) events might have on services were not reported. All interviewees rated themselves around average and indicated that their specific confidence levels ranged from very low to very high, suggesting that the ratings of confidence must be item-specific to be of any value. Interviewees did not have sufficient time to record the type of impacts events had on services.

B.6 IMPACTED BASELINE FORECAST

The impacted baseline forecasts for each service for each year appear in Table B-11. The differences between the baseline and impacted baseline forecasts were calculated as percent changes in the baselines and these differences appear on Table B-12. Much of the impact of the MDFs on the services does not occur until the 1990 to 2000 decade and this impact varies from a -1.5 to an 18.6 percent in 1990 and from a -1.9 percent to 37.2 percent in 2000. For the years 1990 and 2000, voice changed two and eight percent, data changed eight and 16 percent and video changed nine and 27 percent, respectively. The largest change (37 percent) occurred in video teleconferencing and videotext in 2000.

TABLE B-1

GUIDE FOR SELECTING EVENTS (MDFs)

Criteria: Must impact long haul market, significantly, uniquely, somewhat unexpectedly, by 2000

IMPACT AREAS[1] / EVENT CLASS[2]	COST		AVAILABILITY		EASE OF USE		NEED	
	Goes down	Compet Means Goes Up	More of Service	To More People	Easier to Use	Made More Accept.	Greater Need for Service	New Need
TECHNOLOGICAL								
ECONOMIC								
SOCIAL-POLITICAL								

1. Impact areas are areas that, when impacted, will cause people to use more/less of the services; areas used to generate and document impact of events.

2. Event classes are simply three categories used to generate/group events.

TABLE B-2
EVENTS-MARKET DETERMINANT FACTORS

TECHNOLOGICAL

Input

Touch Input Devices:
Widespread use of inexpensive screens/tablets that respond to touch.

Smart Cards:
Plastic microcomputer "smart cards" which are programmable are used extensively in financial transactions.

Voice Recognition:
Inexpensive, voice-recognition devices (e.g., voicewriter that can recognize instructions from spoken voice) become available and are used widely for computer time-sharing and office and home terminals.

Hand-held Terminals:
Widespread use of low cost hand-held terminals that can communicate with a network of computers.

Output

Non-Impact Printing:
Non-impact printing techniques (e.g., thermal processes) replace impact printer for hard copy production.

Flat Output Panels:
Flat, solid-state panels (e.g., plasma panels) replace CRT for soft copy production.

Processing

Microprocessors:
100,000 components per chip, 1 millionth of a meter in size, with a speed of 10 million instructions per second, costing $.04 per logical unit become available (factor of 2 with 1980).

Micromemories:
Catch up to microprocessors in speed and capacity; inexpensive electric memory devices (using techniques like Josephson Junction) as fast as fastest RAM chips with capacities large enough for mass data storage become available.

Biochips:
Chips produced by bacteria make possible the molecular computer, the molecular switch, organic memory devices; computers become much smaller, faster and cheaper.

Fifth Generation Computers:
Emphasize logic, not just power; can hear, talk, develop knowledge; have active memory that incorporates parallel processing; are used on widespread basis.

Artificially Intelligent Expert Machines:
Knowledge-based system capable of bringing specialized knowledge to bear on non-numerical problems (e.g., medical diagnosis, problem solving) become available and are used widely in the home and in business.

Self-Programming Computers:
Computers that can program themselves become available and are used on a widespread basis.

Universal Programming Language:
A standard is established for programming languages reducing programming costs by 25 percent.

Standardization of Software:
Software packages are standardized so they can be used on all systems; one or several models are established for standardizing data base software.

Terminal/Computer Compatibility:
Standards are adopted by various terminal/computer types making possible the communication among all types of terminals/computers throughout the United States.

Transmission

Direct Broadcast Service:
Widespread use of the direct reception of video or audio signals from satellites to individual receiving antennas, by-passing terrestrial transmission and receiving stations.

High-Definition Television:
Widespread use of HDTV which uses a wider bandwidth than conventional TV and gives a higher resolution picture on a large screen.

Voice Store-and-Forward:
Widespread use of this computerized storage-retrieval system for distribution of voice message communication; users dictate messages over the telephone and call in to retrieve them.

Wrist Radio:
Stadium size antennas make possible communications by way of low power wrist radios.

Antenna Material:
Availability of inexpensive light weight antenna.

Satellite Material:

Availability of lighter, less expensive material developed for satellite production.

Fiber Optics:

Connector, capacity and light source (e.g., solid-state injection lasers) improvements made in fiber optics.

Geo-Stationary Platform:

A stationary place in space is developed and provides facilities for tasks ranging from maintaining and servicing to assembling satellites with high power and capacity.

ECONOMIC

Prosperity:

The following occurs - productivity and GNP up, interest rates and unemployment low, and new businesses and markets established.

Recession-Depression:

The following occurs - productivity and GNP down, interest rates and unemployment very high, business failures increase, market shares lost to foreign competition.

Communications Business Shake Down:

Marginal communications business drop out leaving only major corporations, despite pro-competition stance of Government.

Resources:

Battle between resource exploitation and resource conservation ends as need for critical natural resources increases sharply and requires extensive exploration and conservation.

Global Economy:

Domestic-national economies of both developed and developing countries make global economic planning a high priority.

Industries in Space:

The development of products (e.g., semi-conductors) and the providing of services (e.g., earth observation) in space is a multi-billion (dollar) industry.

SOCIAL-POLITICAL

Domestic-International Satellites:

Domestic satellite systems are connected to international networks via inter-satellite links.

Limited Wars:

Limited wars break out in several key corners of the globe (e.g., Middle East).

Orbit Share:

South America demands and obtains its own unique share of the geostationary orbit.

Acceptance of Technology:

Generation raised on computer games and space exploration not only accepts, but welcomes services like electronic mail to the home and the "Office of the Future" at work.

Work at Home:

Workers and management in a work world becoming more service and white-collar oriented spend more time working at home.

Satellite Importation of Workers:

Widespread use of satellites to obtain labor (i.e., the results of labor, like word processing) from other countries.

Self Help:

Decentralized in a world growing more interdependent causes significant increase in local control and self help groups who need many individual networks.

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TABLE B-3

PROBABILITY OF OCCURRENCE

EVENTS - MDFs	YEARS OF OCCURRENCE		
	10% Chance	50/50 Chance	100% Certain
TECHNOLOGY Input			
Touch Input Devices			
Smart Cards			
Voice Recognition			
Hand-held Terminals			
Output			
Non-Impact Printing			
Flat Output Panels			
Processing			
Microprocessor			
Micromemories			
Biochips			
Fifth Generation Computers			
Artif. Intel, Exp. Machines			
Self-Programming Computers			
Universal Programming Language			
Terminal/Computer Compat.			
Standardization of Software			
Transmission			
Direct Broadcast Service			
High Definition Television			
Voice Store-And-Forward			
Wrist Radio			
Antenna Material			
Satellite Material			
Fiber Optics			
Geo-Stationary Platform			

TABLE B-3 (Continued)

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EVENTS - MDFs	YEAR OF OCCURRENCE		
	10% Chance	50/50 Chance	100% Certain
ECONOMIC			
Prosperity			
Recession-Depression			
Communications Business Shake Down			
Resources - Critical Need			
Global Economy			
Industries In Space			
SOCIAL-POLITICAL			
Domestic-International Satellite			
Limited Wars			
Orbit Share			
Acceptance of Technology			
Work at Home			
Satellite Importation of Workers			
Self-Help			
OTHER EVENTS			

LEVEL OF CONFIDENCE: Rating: _______ (1-5; 1 = no basis; 5 = very confident)

Comments: ____________________

TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±N change)

SERVICES / EVENTS - MDFs	VOICE-OVERALL		Message Toll - Residential		Message Toll - Business		Private Line - Telephone		Mobil Radio		Public Radio		Commercial/Religious Radio		Occasional Radio		CATV Music		Recording Channel	
	A	$	A	$	A	$	A	$	A	$	A	$	A	$	A	$	A	$	A	$
TECHNOLOGY																				
Input																				
Touch Input Devices																				
Smart Cards																				
Voice Recognition																				
Hand-held Terminals																				
Output																				
Non-Impact Printing																				
Flat Output Panels																				
Processing																				
Microprocessors																				
Micromemories																				
Biochips																				
5th Generation Computers																				
Artif. Intel. Exp. Mach.																				
Self-Programming Compt.																				
Universal Program. Lang.																				
Standardization of Soft.																				
Term./Computer Compat.																				
Transmission																				
Direct Broadcast Service																				
High Definition Tele.																				
Voice Store-and-Forward																				
Wrist Radio																				
Antenna Material																				
Satellite Material																				
Fiber Optics																				
Geo-Stationary Platform																				

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TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±N change)

SERVICES / EVENTS - MDFs	VOICE-OVERALL		Message Toll - Residential		Message Toll - Business		Private Line - Telephone		Mobile Radio		Public Radio		Commercial/Religious Radio		Occasional Radio		CATV Music		Recording Channel	
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
ECONOMIC																				
Prosperity																				
Recession-Depression																				
Comm. Business Shake Down																				
Resources - Critical Need																				
Global Economy																				
Industries In Space																				
SOCIAL-POLITICAL																				
Domestic-International Sat.																				
Limited Wars																				
Orbit Share																				
Acceptance of Technology																				
Work at Home																				
Sat. Importation of Workers																				
Self Help																				
OTHER EVENTS																				

LEVEL OF CONFIDENCE: Rating ____ (1-5; 1 = no basis, 5 = very confident)

Comments ______________________________
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____
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TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±N change)

SERVICES / EVENTS - MDFs	DATA - OVERALL		Data Transfer		Batch Processing		Data Entry		Remote Job		InquiryResponse		Time Sharing		USPS EMSS		Mailbox		Administrative Message	
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
TECHNOLOGY																				
Input																				
Touch Input Devices					–			–		–										
Smart Cards																				
Voice Recognition																				
Hand-held Terminals																				
Output																				
Non-Impact Printing																				
Flat Output Panels																				
Processing																				
Microprocessors																				
Micromemories																				
Biochips																				
5th Generation Computers																				
Artif. Intel. Exp. Mach.																				
Self-Programming Compt.																				
Universal Program. Lang.																				
Standardization of Soft.																				
Term./Computer Compat.																				
Transmission																				
Direct Broadcast Service																				
High Definition Tele.																				
Voice Store-and-Forward																				
Wrist Radio																				
Antenna Material																				
Satellite Material																				
Fiber Optics																				
Geo-Stationary Platform																				

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TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±N change)

SERVICES / EVENTS - MDFs	DATA - OVERALL		Data Transfer		Batch Processing		Data Entry		Remote Job		Inquiry/Response		Timesharing		USPS EMSS		Mailbox		Administrative Message	
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
ECONOMIC																						
Prosperity																						
Recession-Depression																						
Comm. Business Shake Down																						
Resources - Critical Need																						
Global Economy																						
Industries In Space																						
SOCIAL-POLITICAL																						
Domestic-International Sat.																						
Limited Wars																						
Orbit Share																						
Acceptance of Technology																						
Work at Home																						
Sat. Importation of Workers																						
Self Help																						
OTHER EVENTS																						

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TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need. %: ±N change)

SERVICES / EVENTS - MDFs	Facsimile		Communicating Word Processor		TWX/Telex		Mailgram/Telegram/ Money Order		Point of Sale		Videotext		Telemonitoring		Secure Voice					
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
TECHNOLOGY																				
Input																				
Touch Input Devices																				
Smart Cards																				
Voice Recognition																				
Hand-held Terminals																				
Output																				
Non-Impact Printing																				
Flat Output Panels																				
Processing																				
Microprocessors																				
Micromemories																				
Biochips																				
5th Generation Computers																				
Artif. Intel. Exp. Mach.																				
Self-Programming Compt.																				
Universal Program. Lang.																				
Standardization of Soft.																				
Term./Computer Compat.																				
Transmission																				
Direct Broadcast Service																				
High Definition Tele.																				
Voice Store-and-Forward																				
Wrist Radio																				
Antenna Material																				
Satellite Material																				
Fiber Optics																				
Geo-Stationary Platform																				

TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±N change)

SERVICES / EVENTS - MDFs	Facsimile		Communicating Word Processor		TWX/Telex		Mailgram/Telegram/ Money Order		Point of Sale		Videotext		Telemonitoring		Secure Voice					
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
ECONOMIC																				
Prosperity																				
Recession-Depression																				
Comm. Business Shake Down																				
Resources - Critical Need																				
Global Economy																				
Industries In Space																				
SOCIAL-POLITICAL																				
Domestic-International Sat.																				
Limited Wars																				
Orbit Share																				
Acceptance of Technology																				
Work at Home																				
Sat. Importation of Workers																				
Self Help																				
OTHER EVENTS																				

LEVEL OF CONFIDENCE: Rating _____ (1-5; 1 = no basis, 5 = very confident)

Comments ____

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TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±% change)

SERVICES / EVENTS - MDFs	VIDEO - OVERALL		Network Video		CATV Video		Occasional Video		Recording Channel		Teleconferencing									
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
TECHNOLOGY																				
Input																				
Touch Input Devices					-			-		-										
Smart Cards																				
Voice Recognition																				
Hand-held Terminals																				
Output																				
Non-Impact Printing																				
Flat Output Panels																				
Processing																				
Microprocessors																				
Micromemories																				
Biochips																				
5th Generation Computers																				
Artif. Intel. Exp. Mach.																				
Self-Programming Compt.																				
Universal Program. Lang.																				
Standardization of Soft.																				
Term./Computer Compat.																				
Transmission																				
Direct Broadcast Service																				
High Definition Tele.																				
Voice Store-and-Forward																				
Wrist Radio																				
Antenna Material																				
Satellite Material																				
Fiber Optics																				
Geo-Stationary Platform																				

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TABLE B-4

ESTIMATES OF IMPACTS

(A: 1 = cost, 2 = availability, 3 = ease of use, 4 = need, %: ±N change)

SERVICES / EVENTS - MDFs	VIDEO - OVERALL		Network Video		CATV Video		Occasional Video		Recording Channel		Teleconferencing											
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
ECONOMIC																						
Prosperity																						
Recession-Depression																						
Comm. Business Shake Down																						
Resources - Critical Need																						
Global Economy																						
Industries In Space																						
SOCIAL-POLITICAL																						
Domestic-International Sat.																						
Limited Wars																						
Orbit Share																						
Acceptance of Technology																						
Work at Home																						
Sat. Importation of Workers																						
Self Help																						
OTHER EVENTS																						

LEVEL OF CONFIDENCE: Rating _____ (1-5; 1 = no basis, 5 = very confident)

Comments ______________________________

____

____

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TABLE B-5, EVENT CROSS IMPACTS

MDFs		1 2 3 4 5..................33 34 35 36
Touch Input Devices	1	
Smart Cards	2	
Voice Recognition	3	
Hand-Held Terminals	4	
Non-Impact Printing	5	
Flat Output Panels	6	
Microprocessor	7	
Micromemories	8	
Biochips	9	
Fifth Generation Computers	10	
Artif. Intel, Exp. Machines	11	
Self-Programming Computers	12	
Universal Programming Language	13	
Terminal/Computer Compatibility	14	
Standardization of Software	15	
Direct Broadcast Service	16	
High Definition Television	17	
Voice Store-and-Forward	18	
Wrist Radio	19	
Antenna Material	20	
Satellite Material	21	
Fiber Optics	22	
Geo-Stationary Platform	23	
Prosperity	24	
Recession-Depression	25	
Communications Business Shake Down	26	
Resources - Critical Need	27	
Global Economy	28	
Industries in Space	29	
Domestic-International Satellite	30	
Limited Wars	31	
Orbit Share	32	
Acceptance of Technology	33	
Work at Home	34	
Satellite Importation of Workers	35	
Self-Help	36	

IMPACT SCALE

	R	I
Very Strongly Enhancing	3	2
Strongly Enhancing	2	1 2/3
Enhancing	1	1 1/3
Nil	0	1
Inhibiting	-1	2/3
Strongly Inhibiting	-2	1/3
Very Strongly Inhibiting	-3	0

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TABLE B-6

MEAN YEAR OF OCCURENCE FOR MDF'S

MDF'S	PROBABILITY OF OCCURENCE 10 PCT	50 PCT	100 PCT
1 TOUCH INPUT DEVICES	1985	1990	1994
2 SMART CARDS	1986	1990	1993
3 VOICE RECOGNITION	1987	1994	1999
4 HAND HELD TERMINALS	1984	1989	1993
5 NON-IMPACT PRINTING	1985	1991	1996
6 FLAT OUTPUT PANELS	1987	1992	1998
7 MICROPROCESSOR	1983	1985	1988
8 MICROMEMORIES	1984	1987	1990
9 BIOCHIPS	1994	2001	2009
10 FIFTH GENERATION COMPUTERS	1989	1994	2000
11 ARTIF INTEL, EXP MACHINES	1989	1995	2004
12 SELF-PROGRAMMING COMPUTERS	1990	1996	2003
13 UNIVERSAL PROGRAMMING LANGUAGE	1989	1991	1996
14 TERMINAL/COMPUTER COMPATABILITY	1985	1988	1992
15 STANDARDIZATION OF SOFTWARE	1987	1992	1996
16 DIRECT BROADCAST SERVICE	1985	1989	1993
17 HIGH DEFINITION TELEVISION	1988	1990	1994
18 VOICE STORE AND FORWARD	1984	1987	1991
19 WRIST RADIO	1989	1994	2000
20 ANTENNA MATERIAL	1987	1990	1993
21 SATELLITE MATERIAL	1988	1993	1998
22 FIBER OPTICS	1985	1988	1994
23 GEO-STATIONARY PLATFORM	1994	2003	2004
24 PROSPERITY	1985	1988	1993
25 RECESSION/DEPRESSION	1983	1986	1989
26 COMUNICATIONS BUSINESS SHAKE DOWN	1988	1989	1991
27 RESOURCES - CRITICAL NEED	1986	1988	1993
28 GLOBAL ECONOMY	1991	1996	2005
29 INDUSTRIES IN SPACE	1993	2000	2005
30 DOMESTIC INTERNATIONAL SATELLITE	1989	1994	1999
31 LIMITED WARS	1982	1984	1986
32 ORBIT SHARE	1984	1987	1994
33 ACCEPTANCE OF TECHNOLOGY	1985	1990	1994
34 WORK AT HOME	1988	1996	2001
35 SATELLITE IMPORTATION OF WORKERS	1992	1998	2005
36 SELF-HELP	1987	1993	1996

TABLE B-7

NORMALIZED PROBABILITY OF OCCURENCE FOR MDF'S FOR EACH YEAR

YEARS

MDF'S	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOUCH INPUT DEVICES					0.2	0.9	1.6	2.3	3.1	3.8	4.5	5.6	6.8	7.9	9.0	9.0	9.0	9.0	9.0	9.0	9.0
SMART CARDS							0.9	1.8	2.7	3.6	4.5	6.1	7.6	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
VOICE RECOGNITION							0.6	1.3	2.1	2.9	3.6	4.4	5.2	6.0	6.7	8.1	9.4	10.7	12.1	13.4	13.4
HAND HELD TERMINALS				0.2	0.8	1.5	2.2	2.8	3.5	4.1	5.2	6.2	7.2	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
NON-IMPACT PRINTING					0.3	1.0	1.6	2.3	3.0	3.6	4.3	4.9	5.9	6.9	7.9	8.9	9.9	9.9	9.9	9.9	9.9
FLAT OUTPUT PANELS							0.2	1.2	2.1	3.0	4.0	4.9	5.8	6.8	7.8	8.8	9.7	10.7	11.7	11.7	11.7
MICROPROCESSOR				0.6	1.9	3.2	4.3	5.4	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
MICROMEMORIES					0.7	1.7	2.7	3.6	4.9	6.1	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
BIOCHIPS														1.0	2.3	3.6	4.9	6.2	7.5	8.8	10.1
FIFTH GENERATION COMPUTER									0.3	1.5	2.7	4.0	5.2	6.4	7.6	8.9	10.1	11.4	12.7	14.0	15.2
ARTIF INTEL, EXP MACHINES									0.5	1.4	2.4	3.3	4.3	5.2	6.2	7.1	7.9	8.7	9.5	10.3	11.1
SELF-PROGRAMMING COMPUTER										0.5	1.6	2.7	3.8	4.9	5.9	7.0	8.1	9.3	10.4	11.6	12.7
UNIVERSAL PROGRAMMING LAN										1.1	3.4	5.6	6.7	7.9	9.0	10.1	11.2	11.2	11.2	11.2	11.2
TERMINAL/COMPUTER COMPATA						0.8	1.9	2.9	4.0	5.0	6.0	7.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
STANDARDIZATION OF SOFTWA							0.2	1.1	2.0	2.9	3.7	4.6	5.5	6.9	8.3	9.6	11.0	11.0	11.0	11.0	11.0
DIRECT BROADCAST SERVICE						0.9	1.7	2.6	3.4	4.3	5.3	6.4	7.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
HIGH DEFINITION TELEVISIO									1.0	3.0	4.9	6.2	7.4	8.6	9.9	9.9	9.9	9.9	9.9	9.9	9.9
VOICE STORE AND FORWARD					0.7	1.7	2.7	3.7	4.6	5.6	6.5	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
WRIST RADIO									0.3	1.5	2.7	4.0	5.2	6.4	7.6	8.9	10.1	11.4	12.7	14.0	15.2
ANTENNA MATERIAL								0.9	2.2	3.4	4.7	6.2	7.8	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
SATELLITE MATERIAL								0.3	1.3	2.3	3.3	4.3	5.4	6.4	7.7	9.0	10.2	11.5	12.8	12.8	12.8
FIBER OPTICS						0.8	2.0	3.1	4.2	4.9	5.6	6.3	7.0	7.7	8.4	8.4	8.4	8.4	8.4	8.4	8.4
GEO-STATIONARY PLATFORM													0.2	1.2	2.2	3.1	4.1	5.0	6.0	6.9	7.9
PROSPERITY						0.8	1.9	3.0	4.1	4.9	5.7	[illegible]	7.4	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
RECESSION/DEPRESSION				0.7	1.6	2.5	3.4	4.5	5.7	6.8	6.8	[illegible]	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
COMUNICATIONS BUSINESS SH									0.9	4.4	6.6	[illegible]	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
RESOURCES - CRITICAL NEED							0.8	2.5	4.2	5.0	5.9	6.7	7.6	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
GLOBAL ECONOMY											0.3	1.7	3.0	4.3	5.6	6.9	8.3	9.2	10.1	11.0	11.9
INDUSTRIES IN SPACE													0.9	2.0	3.2	4.4	5.6	6.7	7.9	9.1	10.2
DOMESTIC INTERNATIONAL SA									0.3	1.5	2.6	3.8	5.0	6.2	7.3	8.8	10.3	11.7	13.2	14.7	14.7
LIMITED WARS			0.6	1.8	3.0	4.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
ORBIT SHARE					0.8	1.8	2.9	3.9	4.5	5.1	5.6	6.2	6.7	7.3	7.9	7.9	7.9	7.9	7.9	7.9	7.9
ACCEPTANCE OF TECHNOLOGY					0.2	0.9	1.6	2.3	3.1	3.8	4.5	5.6	6.8	7.9	9.0	9.0	9.0	9.0	9.0	9.0	9.0
WORK AT HOME							0.0	0.8	1.6	2.3	3.1	3.9	4.7	5.5	6.3	7.0	7.8	9.4	11.0	12.5	14.1
SATELLITE IMPORTATION OF												0.6	1.9	3.2	4.5	5.8	7.0	8.3	9.6	11.0	12.3
SELF-HELP							0.4	1.2	1.9	2.7	3.5	4.2	5.0	5.8	7.7	9.7	11.6	11.6	11.6	11.6	11.6

TABLE B-8

EVENT CROSS IMPACT RATINGS

MDF'S

MDF'S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1 TOUCH INPUT DEVICES	-3	-1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1
2 SMART CARDS	-1	-3	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
3 VOICE RECOGNITION	-2	0	-3	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0
4 HAND HELD TERMINALS	1	1	0	-3	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
5 NON-IMPACT PRINTING	0	0	0	0	-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
6 FLAT OUTPUT PANELS	0	0	0	0	1	-3	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 MICROPROCESSOR	0	3	0	3	1	1	-3	2	1	2	2	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
8 MICROMEMORIES	0	3	0	3	1	1	2	-3	1	2	2	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
9 BIOCHIPS	0	2	1	1	0	0	2	2	-3	2	2	2	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
10 FIFTH GENERATION CO	0	2	1	1	0	0	1	1	1	-3	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
11 ARTIF INTEL, EXP MA	0	2	1	1	0	0	1	1	1	1	-3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
12 SELF-PROGRAMMING CO	0	2	1	1	0	0	1	1	1	1	1	-3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
13 UNIVERSAL PROGRAMMI	0	1	0	1	0	0	0	0	0	0	0	0	-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
14 TERMINAL/COMPUTER C	0	1	0	1	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
15 STANDARDIZATION OF	0	1	0	1	0	0	0	0	0	0	0	0	1	1	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
16 DIRECT BROADCAST SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
17 HIGH DEFINITION TEL	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18 VOICE STORE AND FOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
19 WRIST RADIO	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
20 ANTENNA MATERIAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	-3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
21 SATELLITE MATERIAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	-3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
22 FIBER OPTICS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 GEO-STATIONARY PLAT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0
24 PROSPERITY	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	-3	-3	-2	1	1	1	1	-1	2	1	1	-1	1
25 RECESSION/DEPRESSIO	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-3	-3	2	-1	-1	-1	-1	1	-1	2	1	-2	2
26 COMMUNICATIONS BUSIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	-1	0	0	0	0	-1	-1	0	0
27 RESOURCES - CRITICA	-1	0	-1	0	-1	-1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	-2	2	1	-3	2	2	1	2	2	1	0	0	0
28 GLOBAL ECONOMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	-1	-1	-3	2	2	-1	-1	1	0	2	0
29 INDUSTRIES IN SPACE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	-1	0	-1	1	-3	1	-1	1	1	0	0	0
30 DOMESTIC INTERNATIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	1	0	0	0	0	0	1	-3	-1	1	0	0	0	0
31 LIMITED WARS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-1	-1	-1	-3	-1	-1	0	0	0
32 ORBIT SHARE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-3	0	0	0	0
33 ACCEPTANCE OF TECHN	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	-1	-1	2	1	1	1	0	1	-3	1	0	0
34 WORK AT HOME	1	0	0	1	0	0	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-3	0	0
35 SATELLITE IMPORTATI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	-3	0
36 SELF-HELP	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	-3

TABLE B-9

MODIFIED NORMALIZED PROBABILITY OF OCCURENCE FOR MDF'S FOR EACH YEAR

YEARS

MDF'S	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOUCH INPUT DEVICES					0.2	1.0	1.7	2.4	2.9	3.4	3.9	4.6	5.5	7.2	9.6	9.6	9.6	9.6	9.6	9.6	9.6
SMART CARDS							1.1	2.8	4.6	6.4	7.9	9.1	9.1	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
VOICE RECOGNITION							0.5	1.2	2.0	2.7	3.5	4.3	5.1	5.9	6.6	7.7	8.7	9.5	10.2	10.7	10.7
HAND HELD TERMINALS				0.1	1.0	2.1	3.5	4.8	6.1	7.2	8.3	8.3	8.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
NON-IMPACT PRINTING					0.3	0.9	1.6	2.4	3.1	3.8	4.5	5.2	6.1	6.8	7.5	8.0	8.4	8.4	8.4	8.4	8.4
FLAT OUTPUT PANELS							0.2	1.0	2.0	3.0	4.0	5.0	5.9	6.8	7.5	8.1	8.6	8.9	9.1	9.1	9.1
MICROPROCESSOR				0.8	2.8	4.8	5.9	6.4	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
MICROMEMORIES					0.8	2.3	3.8	5.2	6.4	7.0	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
BIOCHIPS														0.4	0.9	1.5	2.2	2.9	3.6	4.2	4.9
FIFTH GENERATION COMPUTER									0.2	1.1	2.3	3.5	4.9	6.2	7.3	8.3	9.0	9.4	9.4	9.0	8.1
ARTIF INTEL, EXP MACHINES									0.2	0.8	1.5	2.3	3.1	3.9	4.6	5.3	5.8	6.2	6.5	6.7	6.8
SELF-PROGRAMMING COMPUTER										0.3	0.9	1.7	2.6	3.5	4.5	5.3	6.1	6.8	7.4	7.7	7.9
UNIVERSAL PROGRAMMING LAN										1.1	3.6	6.0	7.1	8.1	8.9	9.6	10.1	10.1	10.1	10.1	10.1
TERMINAL/COMPUTER COMPATA						0.9	2.4	4.0	5.5	6.5	7.2	7.3	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
STANDARDIZATION OF SOFTWA							0.2	1.1	2.0	2.9	3.8	4.7	5.6	7.0	8.3	9.5	10.5	10.5	10.5	10.5	10.5
DIRECT BROADCAST SERVICE						0.8	1.8	2.8	3.8	4.8	5.8	6.6	7.2	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
HIGH DEFINITION TELEVISIO									1.0	3.4	5.8	7.1	7.9	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
VOICE STORE AND FORWARD					0.8	1.8	2.9	4.0	4.9	5.7	6.5	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
WRIST RADIO									0.2	1.1	2.3	3.6	4.9	6.3	7.4	8.4	9.2	9.5	9.4	8.9	7.9
ANTENNA MATERIAL								0.9	2.5	4.1	5.6	7.1	8.0	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
SATELLITE MATERIAL								0.2	1.1	2.1	3.2	4.4	5.5	6.5	7.6	8.5	9.1	9.4	9.3	9.3	9.3
FIBER OPTICS						0.8	2.1	3.3	4.5	5.1	5.7	6.3	6.8	7.3	7.8	7.8	7.8	7.8	7.8	7.8	7.8
GEO-STATIONARY PLATFORM													0.1	0.4	0.7	1.1	1.5	2.0	2.4	2.8	3.3
PROSPERITY						1.3	2.6	3.2	3.2	2.8	2.0	1.1	0.2	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
RECESSION/DEPRESSION				0.8	1.5	1.9	1.9	1.4	0.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
COMMUNICATIONS BUSINESS SH									0.9	3.5	5.0	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
RESOURCES - CRITICAL NEED							0.9	2.6	4.2	4.9	5.7	6.5	7.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
GLOBAL ECONOMY											0.2	1.1	2.1	3.1	4.0	5.0	5.8	6.4	6.9	7.4	7.9
INDUSTRIES IN SPACE													0.4	0.9	1.5	2.2	2.8	3.5	4.1	4.8	5.3
DOMESTIC INTERNATIONAL SA									0.2	1.3	2.5	3.8	5.0	6.2	7.3	8.6	9.6	10.6	11.4	12.1	12.1
LIMITED WARS			0.6	1.7	2.7	3.9	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
ORBIT SHARE					0.8	2.0	3.2	4.3	4.8	5.2	5.6	6.0	6.4	6.8	7.3	7.3	7.3	7.3	7.3	7.3	7.3
ACCEPTANCE OF TECHNOLOGY					0.1	0.9	1.9	2.9	4.0	5.0	6.0	7.1	7.7	7.7	7.0	7.0	7.0	7.0	7.0	7.0	7.0
WORK AT HOME							0.0	0.4	0.9	1.5	2.2	3.0	3.7	4.5	5.2	5.9	6.6	7.5	8.0	7.9	7.1
SATELLITE IMPORTATION OF												0.4	1.3	2.1	2.9	3.6	4.4	5.0	5.6	6.2	6.8
SELF-HELP							0.3	1.1	2.0	3.0	4.1	5.1	6.1	7.0	8.8	9.5	8.7	8.7	8.7	8.7	8.7

TABLE B-10

EVENT IMPACTS ON SERVICES

SERVICES

MDF'S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1 TOUCH INPUT DEVICES	1	1	0	0	0	0	0	0	1	0	0	5	3	3	0	1	0	1	0	2	0	2	2	5	0	0	0	0	0	2	2
2 SMART CARDS	0	0	0	0	0	0	0	0	1	0	0	3	2	2	0	3	1	1	0	0	0	1	10	3	0	3	0	3	0	2	0
3 VOICE RECOGNITION	0	0	0	0	0	0	0	0	0	0	0	3	3	3	0	0	1	3	0	8	0	1	1	2	1	1	0	0	0	0	1
4 HAND HELD TERMINALS	1	1	0	1	0	0	0	0	1	0	0	2	1	3	0	2	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0
5 NON-IMPACT PRINTING	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
6 FLAT OUTPUT PANELS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
7 MICROPROCESSOR	2	2	1	1	0	0	0	0	1	2	2	1	1	1	1	1	1	1	0	1	0	0	1	2	1	1	0	1	2	2	3
8 MICROMEMORIES	0	0	0	0	0	0	1	2	2	1	3	1	1	2	0	1	1	1	2	1	0	2	1	2	1	1	0	1	2	2	3
9 BIOCHIPS	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	1	0	1	0	0	1	1	1	1	0	1	2	2	3
10 FIFTH GENERATION COMPUTERS	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 ARTIF INTEL, EXP MACHINES	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
12 SELF-PROGRAMMING COMPUTERS	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
13 UNIVERSAL PROGRAMMING LANGUAGE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14 TERMINAL/COMPUTER COMPATABILIT	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
15 STANDARDIZATION OF SOFTWARE	0	0	0	1	0	0	0	0	0	2	0	0	2	2	0	0	0	0	0	3	0	0	2	2	0	0	0	0	0	0	0
16 DIRECT BROADCAST SERVICE	0	0	0	0	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	-1	-2	-2	5	0
17 HIGH DEFINITION TELEVISION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	2	3	0
18 VOICE STORE AND FORWARD	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	-2	-2	0	0	0	-1	0	0	0	0	0	0	0	0	0
19 WRIST RADIO	1	1	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	2	2	2
20 ANTENNA MATERIAL	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2
21 SATELLITE MATERIAL	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	2	2
22 FIBER OPTICS	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23 GEO-STATIONARY PLATFORM	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
24 PROSPERITY	2	2	2	4	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	0	1	3	2	1	1	0	3	2	3	5
25 RECESSION/DEPRESSION	-1	-1	-1	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-2	-1	-1	-1	0	-1	-1	-1	-5
26 COMUNICATIONS BUSINESS SHAKE D	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	1	0	0	0	0	-1	0	0	0
27 RESOURCES - CRITICAL NEED	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-2	0	0	0	0	0	0	3
28 GLOBAL ECONOMY	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1
29 INDUSTRIES IN SPACE	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	2	3	5
30 DOMESTIC INTERNATIONAL SATELLI	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	1	1	1	1
31 LIMITED WARS	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
32 ORBIT SHARE	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	-1
33 ACCEPTANCE OF TECHNOLOGY	0	0	0	3	0	0	0	1	2	0	0	0	0	0	5	3	3	2	0	5	0	5	5	5	0	0	0	2	1	2	5
34 WORK AT HOME	2	2	0	0	0	0	0	0	0	1	0	0	3	0	1	1	1	2	0	0	0	0	0	1	0	0	0	0	0	0	2
35 SATELLITE IMPORTATION OF WORKE	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
36 SELF-HELP	2	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

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TABLE B-11
IMPACTED BASELINE FORECAST FOR EACH SERVICE FOR EACH YEAR

SERVICE	YEAR 1980	1990	2000
VOICE (1000s HVCs)			
MTS (RESIDENTIAL)	593.0	1319.2	2896.7
MTS (BUSINESS)	1588.0	4215.0	9702.4
PRIVATE LINE	644.4	2649.4	7147.7
MOBILE	1.4	36.7	117.6
PUBLIC RADIO	0.3	1.8	2.6
COMMERCIAL AND RELIGIOUS	0.5	2.0	3.2
OCCASIONAL	1.2	2.4	3.7
CATV MUSIC	0.1	0.3	1.2
RECORDING	0.0	0.0	0.9
TOTAL	2828.9	8226.8	19875.9
DATA (TERABITS/YR)			
DATA TRANSFER	464.0	1460.8	6844.5
BATCH PROCESSING	304.0	951.8	1755.6
DATA ENTRY	380.0	2167.6	8715.4
REMOTE JOB ENTRY	165.0	1413.6	2825.2
INQUIRY/RESPONSE	165.0	1462.9	3842.5
TIMESHARING	94.0	277.2	545.6
USPS/EMSS	0.0	361.7	1084.2
MAILBOX	0.2	5.1	13.5
ADMINISTRATIVE MESSAGES	48.5	316.0	1025.1
FACSIMILE	235.5	549.4	1253.0
COMMUNICATING WORD PROCE	17.1	131.2	519.3
TWX/TELEX	1.2	1.6	2.2
MAILGRAM/TELEGRAM/MONEY	0.4	0.9	1.8
POINT OF SALE	12.0	254.3	468.4
VIDEOTEXT/TELETEXT	0.1	321.7	1258.3
TELEMONITORING SERVICE	0.1	0.8	3.6
SECURE VOICE	5.3	163.3	944.4
TOTAL	1892.3	9839.9	31102.6
VIDEO (TRANSPONDERS)			
NETWORK	10.0	42.9	42.0
CATV	34.0	82.4	68.2
OCCASIONAL	19.0	55.4	47.9
RECORDING CHANNEL	0.0	0.0	2.7
TELECONFERENCING	3.0	155.9	245.3
TOTAL	66.0	336.7	406.0

TABLE B-12
PERCENT DIFFERENCE BETWEEN BASELINE AND IMPACTED BASELINE FORECASTS

SERVICE	YEAR 1980	YEAR 1990	YEAR 2000
VOICE			
MTS (RESIDENTIAL)	0.0	3.1	9.8
MTS (BUSINESS)	0.0	2.4	9.1
PRIVATE LINE	0.0	1.6	5.7
MOBILE	0.0	5.2	14.0
PUBLIC RADIO	0.0	(1.5)	(0.9)
COMMERCIAL AND RELIGIOUS	0.0	(1.5)	(0.9)
OCCASIONAL	0.0	0.2	1.7
CATV MUSIC	0.0	1.0	1.8
RECORDING	0.0	0.0	8.6
TOTAL	0.0	2.3	8.0
DATA			
DATA TRANSFER	0.0	4.3	9.7
BATCH PROCESSING	0.0	4.4	7
DATA ENTRY	0.0	10.6	19
REMOTE JOB ENTRY	0.0	9.2	21.8
INQUIRY/RESPONSE	0.0	13.0	24.4
TIMESHARING	0.0	3.4	4.9
USPS/EMSS	0.0	6.9	8.8
MAILBOX	0.0	3.9	6.0
ADMINISTRATIVE MESSAGES	0.0	5.3	9.9
FACSIMILE	0.0	1.0	1.9
COMMUNICATING WORD PROCE	0.0	12.1	29.7
TWX/TELEX	0.0	0.0	0.0
MAILGRAM/TELEGRAM/MONEY	0.0	7.1	10.4
POINT OF SALE	0.0	18.6	30.1
VIDEOTEXT/TELETEXT	0.0	17.0	37.2
TELEMONITORING SERVICE	0.0	1.4	3.0
SECURE VOICE	0.0	4.0	5.6
TOTAL	0.0	8.3	15.7
VIDEO			
NETWORK	0.0	2.2	4.9
CATV	0.0	8.4	19.6
OCCASIONAL	0.0	6.6	16.9
RECORDING CHANNEL	0.0	0.0	32.6
TELECONFERENCING	0.0	12.2	42.6
TOTAL	0.0	9.0	30.1

APPENDIX C
MARKET DISTRIBUTION MODEL

The market distribution model (MDM) is a set of internal programs (see Figure C-1) used to facilitate the interface between market research and the quantitative results which are needed to support market planning. It uses 64 data bases (as given below in Table C-1) along with algorithms relating size and distance to determine the attractiveness between standard metropolitan statistical areas (SMSAs). This relationship was developed for each of the 31 services in the baseline forecast (using the percentages given in Table C-2) based on primary and secondary research as to the relationship of the data bases to the services. This allowed the traffic to be spread throughout the United States to the various SMSAs. The steps below explain in more detail the use of MDM.

1. Determine the desired geographic/market segment to be addressed.
2. Select a set of data bases from within the MDM which reflect the service's characteristics.
3. Develop weighting factors for each selected data base. The weighting factor represents a statistical measure which assigns a relative value to each data base to reflect their individual importance.
4. The computerized model is then utilized to record assumptions for the weighting factors, statistically validate applicability of data base selection to form a weighted sum of the data bases (all of which have been converted to percentages), and then use the distance sensitivity measure as an input to an algorithm which converts the total static data base to a dynamic (flow) one.
5. This newly formed dynamic data base is combined in a weighted fashion with the previously selected dynamic data bases to create a final SMSA paired service which contains a relative value measuring communication potential between all selected SMSA's.
6. This result is normalized so that the total of all individual route values between SMSA's sums to 100%.
7. The data file can now be used to examine the relative demand potential between SMSA pairs.

A unique aspect of this model is the creation of "artificial SMSAs." An artificial SMSA is created to represent that area of a state located outside of the designated SMSA. The statistics for this area are created by subtracting the designated SMSA statistics from the state statistics. For instance, population of an artificial SMSA is: State population - State Designated SMSAs. More detail on the creation and use of artificial SMSAs is given in the Net Long Haul Appendix.

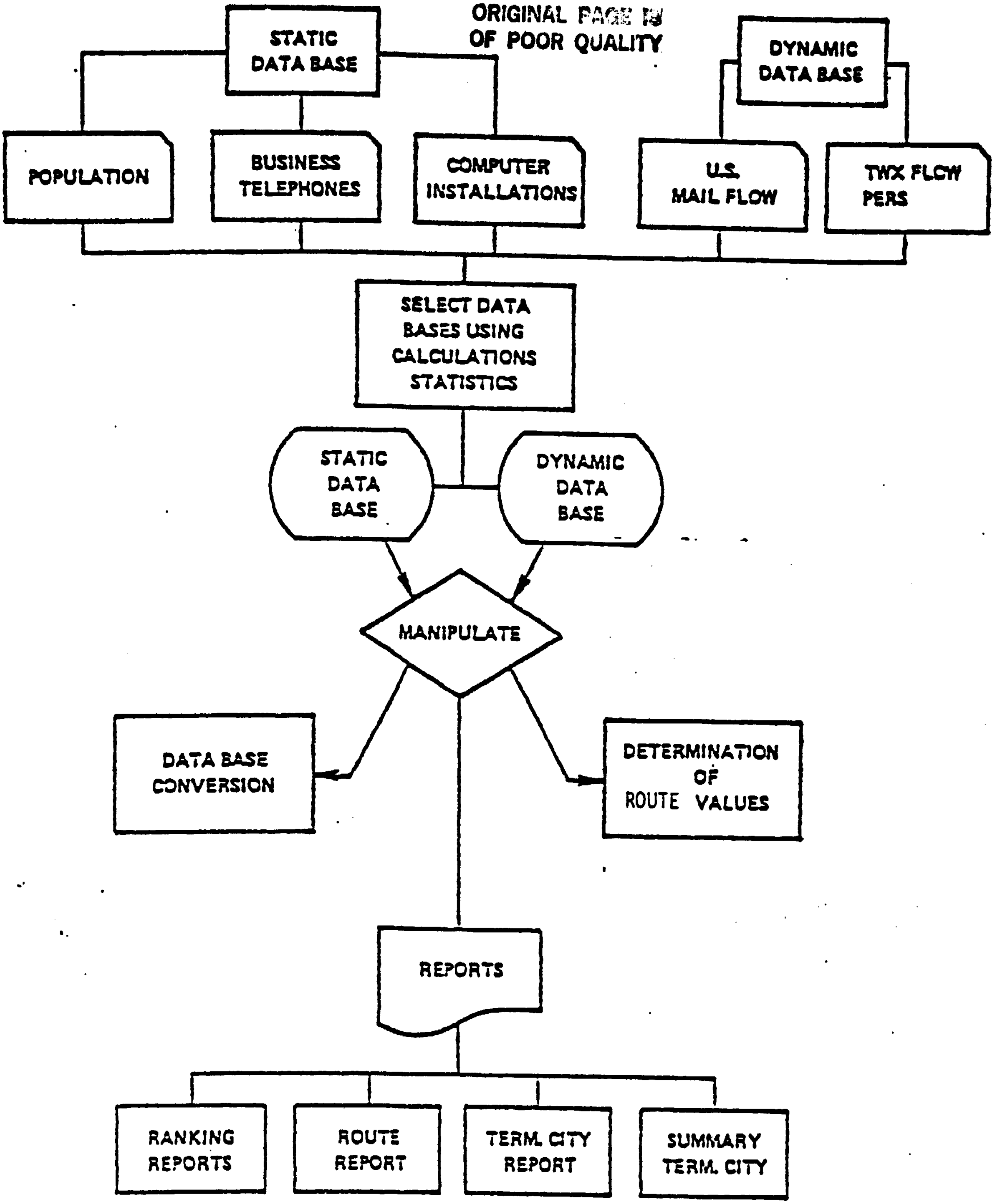

FIGURE C-1. MARKET DISTRIBUTION MODEL

TABLE C-1. FILES USED WITH MDM

	FILE NAME	SMSA SOURCE	STATE SOURCE
1.	SMSA Number		
2.	SMSA Name	Commerce	
3.	Regional Name	Commerce	
4.	SCSA Numbers	Commerce	
5.	Time Zones	Rand McNally	
6.	Artificial V&H Coordinates	Standard Table	
7.	State Capital		
8.	Land Area		Almanac
9.	Population	1980 Census	1980 Census
10.	Projected 1990 population in thousands and % change 1980 to 1990	Census of Governments	1981 Rand McNally (R/M)
11.	Number of locations over 100,000		R/M
12.	Number of locations over 50,000		R/M
13.	Number of locations over 25,000		R/M
14.	Number of locations over 10,000		R/M
15.	Number of locations over 5,000		R/M
16.	Number of locations over 2,500		R/M
17.	Number of locations over 1,000		R/M
18.	1979 Per Household Income (top 100, whole dollars)	Marketing Economics Institute	R/M
19.	Personal Income		
	1978	Bureau of Economic Affairs 1980 (B.E.A.)	
	1990	B.E.A.	
	2000	B.E.A.	
20.	Employment (Non Farm)		
	1978	B.E.A.	
	1990	B.E.A.	
	2000	B.E.A.	

TABLE C-1. FILES USED WITH MDM (Continued)

	FILE NAME	SMSA SOURCE	STATE SOURCE
21.	Transportation, Communications and Public Utilities Employment		
	1978	B.E.A.	
	1990	B.E.A.	
	2000	B.E.A.	
22.	Retail Trade Employment		
	1978	B.E.A.	
	1990	B.E.A.	
	2000	B.E.A.	
23.	Finance, Insurance and Real Estate Employment		
	1978	B.E.A.	
	1990	B.E.A.	
	2000	B.E.A.	
24.	Service Employment		
	1978	B.E.A.	
	1990	B.E.A.	
	2000	B.E.A.	
25.	Population		
	1978	B.E.A.	
	1990	B.E.A.	
	2000	B.E.A.	
26.	Number of Residential Telephones	FCC Common Carrier Statistics	FCC Stats 1980
27.	Number of One-Way CATV Households	Television Fact-Book 1980	Television Fact-Book 1980
28.	Number of Two-Way CATV Households	Television Fact-Book 1980	Television Fact-Book 1980
29.	College Population	1977 Census of Governments (Census Bureau 1979)	1977 Census of Governments
30.	Number of Business Telephones	FCC Stats 1980	FCC Stats 1980
31.	1977 Number of Hospital Beds (in thousands)	1977 Census (Data Book)	1977 Census (Data Book)

TABLE C-1. FILES USED WITH MDM (Continued)

	FILE NAME	SMSA SOURCE	STATE SOURCE
32.	Number of Headquarters of Top 1,000 Industrial Corporations	Fortune Double 500 Directory	
33.	Number of Top 50 Commercial Bank Headquarters	R/M	
34.	Number of Top 50 Insurance Company Headquarters	R/M	
35.	Number of Top 50 Retailing Company Headquarters	R/M	
36.	Number of Top 50 Transportation Company Headquarters	R/M	
37.	1977 Total Bank Deposits in Millions of Dollars - June	State/Metropolitan Area Data Book 1979	
38.	Automatic Clearing House Locations and Federal Reserve Locations	Federal Reserve Board 1982	
39.	1978 Retail Sales ($1,000)	Federal Reserve Board 1981	
40.	Value Added by Manufacturing	R/M	
41.	Principal Business Center Interaction (City Rating)	R/M	
42.	TWX Billings	WU - 1978	
43.	TWX Billings Elapsed Time	WU - 1978	
44.	TWX Terminals	WU - 1978	
45.	Telex Terminals	WU - 1978	
46.	Microwave Circuits	WU - 1978	
47.	Prime AT&T Market	WU - 1982	
48.	WU Prime Rate Center	WU - 1982	
49.	Mail Flow	U.S.P.S. - 1977 (Mail Flow)	

TABLE C-1. FILES USED WITH MDM (Continued)

	FILE NAME	SMSA SOURCE	STATE SOURCE
50.	P.O. Electronics Mail Facilities	1982 - U.S.P.S.	
51.	Number of Main Frames Used in Business, Finance and Insurance	International Data Corporation 1980	
52.	Computer Terminal Locations	1980	
53.	Computer and Data Processing Receipts	1977 Economic Census	
54.	Receipts of Management, Consulting and P.R. Services Industries (in millions of dollars)	1977 Economic Census	
55.	Manufacturing Industry Employment	1977 Census of Whole-Trade	
56.	EBI - Economic Business Indicator	Sales and Marketing Management Magazine	
57.	Number of Earth Stations	Satellite Review Book	
58.	1977 Local Full-Time Government Employees	1977 Census of Governments	
59.	Full-Time State/Local Employees (in thousands)		1977 Census of Government
60.	1976 Total Federal Employees (as of December) 1978 1990 2000	Commerce 1977 Census of Governments	1977 Census of Governments
61.	Total Military Employees 1978 1990 2000	Commerce 1977 Census of Governments	1977 Census of Governments
62.	Federal Government Data Processing Inventory	General Services Administration	
63.	Federal Government Workers in Data Processing	General Services Administration	
64.	WESTAR Services	WU - 1977	

TABLE C-2. PERCENTAGES (WEIGHTINGS) USED TO REFLECT DATA BASE AND SERVICE RELATIONSHIPS

	DATA BASES																			
SERVICES	8	9	26	30	37	60	31	19	21	23	22	50	20	24	61	59	38	52	53	43
MTS (Residential)	20		50					20					10							
MTS (Business)				40	10	10			10	10				10		10				
Private Line				40	15	10				10						10			15	
Mobile		10		50	15					10	10					5				
Public Radio - LD																				
Commercial and Religious - LD																				
Occasional - LD																				
CATV Music - LD																				
Recording - LD																				
Data Transfer		10			20	10				15				10		5	5	15	10	
Batch Processing		10			20	10				15				10		5	5	15	10	
Data Entry		10			20	10				15				10		5	5	15	10	
Remote Job Entry		10			20	10				15				10		5	5	15	10	
Inquiry/Response		10			20	10				15				10		5	5	15	10	
Timesharing		10			20	10				15				10		5	5	15	10	
USPS/EMSS		10		20	20	10				15				10		5	5	5	10	
Mailbox		10		20	20	5		5				15	10			5			10	
Administrative Messages		10		20	20	5		5				15	10			5			10	
Facsimile		10		20	20	5		5				15	10			5			10	
Communicating Word Processors		10		20	20	5		5				15	10			5			10	
TWX/Telex		10		20	20	5		5				15	10			5			10	
Mailgram/Telegram/Money Orders		30		10				10												50
Point of Sale		30		10			10				30		10					10		
Videotext/Teletext	10	10	10	25	20	10				10						5				
Telemonitoring Service		50			10			20					20							
Secure Voice				20			15								60	5				
Network - LD*																				
CATV - LD																				
Occasional - LD																				
Recording Channel - LD																				
Teleconferencing - LD																				

*LD - All radio and video traffic is defined as satellite traffic.

APPENDIX D
POTENTIAL CPS USER CLASSES AND THEIR CHARATERISTICS

D.1 INTRODUCTION

The purpose of Task 1.2, Potential CPS User Classes, was to identify and characterize the classes of potential CPS users. The classes identified were subgroups of the general categories of business, Government, institutional and private users. Over 100 characteristics were used to describe each subgroup. Information used to identify and characterize the various users was obtained from primary and secondary research efforts.

D.2 MAJOR STEPS

The following major steps were conducted in the development of the descriptions of potential CPS user classes:

a. Selection of a sample of users for telephone interviewing
b. Development of the interview procedure
c. Conducting the interviews
d. Analysis of the survey results.

Each of these steps are briefly outlined.

D.3 SELECTION OF SAMPLE

Selecting the sample of users to interview involved the following activities:

a. Conducting secondary research to identify potential user classes and representatives of the classes and to define these classes.
b. Reviewing lists of users representing most subclasses of users throughout the United States.
c. Identifying users through Western Union's network of 500 Sales Managers and Representatives throughout the United States.

The definitions of the potential user classes are presented in Table D-1. Over 1,500 representatives of business, Government and institutional classes were identified (the effort involving private users is described below), and about 20 percent (i.e., 300) were selected for interviewing. Representatives were selected on the basis of the total number of representatives in their user class, geography, and size. Size was defined in terms of sales dollars, number of employees, and/or number of customer/clients.

An effort was made to collect information on private users from public and private organizations known or believed to have relevant information about the telecommunication needs of private users. The following organizations were contacted:

a. Agriculture Research Institute
b. Bertman Cable Consulting Group
c. Business and Industry Division - Bureau of the Census
d. Business Outlook Division - Department of Commerce
e. Economic Division - Federal Communications Commission
f. Information Industry Association
g. National Apartment Association
h. National Association of Realtors
i. National Cable Television Association
j. National Mutlihousing Council
k. National Telecommunications and Information Administration
l. National Rural Telephone Cooperative Association
m. Office of Multifamily Housing Development - Department of Housing and Urban Development
n. Office of Policy Development and Research - Department of Housing and Urban Development
o. Satellite Television Corporation
p. Statistical Reporting Service - Department of Agriculture
q. Subcommittee on Telecommunications - U.S. House of Representatives
r. Communications Satellite Corporation

Some information was obtained on the volume of telephone traffic, interest in direct broadcast services, and price/demand relationships for residential homes, multi-family dwellings and farms. However, this information was too limited and too inconsistent to analyze and present. Consequently, no further effort was spent on characterizing the private users, and all subsequent discussions presented below pertain only to business, Government and institutional user classes.

D.4 DEVELOPMENT OF INTERVIEW PROCEDURES

Development of the interview procedures and instrumentation involved the following activities:

a. Drafting the guidelines and the interview instrument
b. Field testing the procedure and the instrument
c. Making necessary modifications and improvements based on test results.

The final user survey is presented after Table D-1. The first page summarizes the contents of the instrument which include: introductory information, interviewee information, user information, and information on general communications, voice, data and video.

D.5 CONDUCTING THE INTERVIEWS

Of the 300 representatives selected for telephone interviewing, 253 were actually interviewed and provided information on the major items covered in the interview. About fifteen percent (i.e., 47) were not included because they were not reachable, would not cooperate or provided insufficient information to be included.

D.6 ANALYSIS OF SURVEY RESULTS

Highlights of the user survey are presented in Table D-2. These highlights are presented in terms of the sample, budget, volume, price-demand-performance, customer premise services (i.e., use, features influencing use, actual result of

use) and needs and services (i.e., new delivery modes/applications, intra- inter-needs, channel rates in use, peak hours, and video teleconferencing use).

Following Table D-2 are over 100 tables presenting the analysis of each item in the user survey. The question number which generated the data that were analyzed in the table is noted in the heading of each table.

TABLE D-1. DEFINITIONS OF USER CLASSES

BUSINESS

Manufacturing (20 - 39)

Includes establishments engaged in the mechanical or chemical transformation of materials or substances into new products. Establishments are usually described as plants, factories, or mills and characteristically use power driven machines and materials handling equipment. Establishments engaged in assembling component parts of manufactured products are also considered manufacturing if the new product is neither a structure nor other fixed improvement. Also included is the blending materials such as lubricating oils, plastics, resins or liquors.

The new product of a manufacturing establishment may be "finished" in the sense that it is ready for utilization or consumption, or it may be "semifinished" to become a raw material for an establishment engaged in further manufacturing.

Transportation (40 - 47)

Includes establishments providing to the general public or to other business enterprises passenger and freight transportation.

Utilities (48 - 49)

Includes the establishment engaged in the generation, transmission and/or distribution of electricity, gas, steam, or common carrier methods of communication.

Retail/Wholesale (50 - 59)

Retail includes establishments engaged in selling merchandise for personal or household consumption, and rendering services incidental to the sale of the goods. Often retail establishments are classified by kind of business according to the principle lines of commodities sold (groceries, hardware), or the usual trade designation (drug store, cigar store).

Wholesale includes establishments or places of business primarily engaged in selling merchandise to retailers or to wholesalers acting as agents or brokers in buying merchandise for or selling merchandise to such persons or companies.

Finance/Insurance (60 - 67)

Includes establishments operating primarily in the fields of finance, insurance and real estate. Finance includes banks and trust companies, credit agencies other than banks, holding companies, other investment companies, brokers and dealers in securities and commodity contracts, and security and commodity exchanges. Insurance covers carriers of all types of insurance and insurance agents and brokers. Real estate includes owners, lessors, lessees, buyers, sellers, agents and developers of real estate.

TABLE D-1. DEFINITIONS OF USER CLASSES (Continued)

Professional Business Services (73 - 89)

Includes establishments primarily engaged in rendering services, not elsewhere classified, to business establishments on a fee or contract basis, such as advertising, mailing services; building maintenance services; employment service; management and consulting services; protective services, equipment rental and leasing (except finance leasing), commercial research, development and testing, photofinishing, and personal supply services.

Other Miscellaneous Business (01 - 89)

Includes those business servies not elsewhere classified.

GOVERNMENT

Federal (91 - 97, 43)

Includes offices of the Executive, Legisiation and Jidiciary Branches of the U.S. Government.

State and Local (91 - 97)

Includes offices of Executive, Legislative Bodies and General Government not elsewhere classified.

INSTITUTION

Health (80)

Includes establishments primarily engaged in furnishing medical, surgical and other health services to persons.

Education (82)

Includes establishments furnishing formal academic or technical courses, correspondence schools, commercial and trade schools, and libraries.

WESTERN UNION TELEGRAPH COMPANY

Government Systems Division

March 17, 1982

USER SURVEY

Summary Outline

Introductory Information

- Purpose of Call
- Feedback to Participants
- NASA's Role
- Customer Premises Services
- Procedures

Interviewee Information

User Information

- Function - Subclass
- Location
- Size

General Communications

- Volume - Growth
- Inter-Intra Breakdown
- Price/Demand/Performance
- Distance Distribution
- Customer Premises Services
- Services to be Added

Voice

- Volume
- Use of Applications
- Inter-Intra Breakdown
- Peak Hour

Data

- Volume
- Centralized-Decentralized
- Use of Applications
- Inter-Intra Breakdown
- Peak Hour

Video

- Use of Video Conferencing
- Volume
- Type of Facilities
- Purpose and Reason for Use
- Intra-Inter Breakdown
- Peak Hour

INTRODUCTORY INFORMATION

Purpose of Call

I am "__________", and I am calling from the Government Systems Division of the Western Union Telegraph Company. We are conducting a study for the National Aeronautics and Space Administration. A key part of this study is a survey of present and planned communications needs and capabilities of business, Government and institutional organizations. Your participation in this survey would be greatly appreciated.

Feedback to Participants

Information from this survey, initially, will be used by NASA and, ultimately, by providers and users, like yourself, of the various services. The results of this survey, which focuses on present and future communications needs for services, will be shared with you. You will be sent a summary report of the findings.

NASA's Role

NASA has been involved in communications satellite technology development, and one of the areas it has focused on is the development and demonstration of technology for 30/20 GHz or Ka-Band satellite systems. This is an area of high risk where the private sector has been reluctant to enter, yet it is an area that is critical to our economic development.

Customer Premises Services

The provisions of Customer Premises Services (CPS) has been identified as important to fully realize the benefits of the 30/20 GHz technology. CPS is characterized as communications services supplied directly to the customer through small earth terminals located on his premises or through a local customer shared earth station with dedicated "tail" connections directly to the customer.

Procedures

The questions we would like to ask you will focus on:

- Which services do you use?
- What is the current volume of each service you use now?
- What is the growth rate of the volume for each service?
- What are the views of, and plans for, using Customer Premises Services to meet your communications needs?

We will be asking these types of questions about a variety of voice, video and data services, and we will need to talk with the individuals you think are best able to answer these questions.

Neither your organization's name nor the names of the individuals we interview will be disclosed to NASA or anyone else. All information will be presented in summary form and the information you provide us will be strictly confidential.

We expect the interview to take about one-half hour to complete.

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INTERVIEWEE INFORMATION

NAME ____________________

ADDRESS ____________________

____

PHONE ____________________

TITLE ____________________

YEARS EXPERIENCE IN TELECOMMUNICATIONS ____________

NAME ____________________

ADDRESS ____________________

____

PHONE ____________________

TITLE ____________________

YEARS EXPERIENCE IN TELECOMMUNICATIONS ____________

NAME ____________________

ADDRESS ____________________

____

PHONE ____________________

TITLE ____________________

YEARS EXPERIENCE IN TELECOMMUNICATIONS ____________

NAME ____________________

ADDRESS ____________________

____

PHONE ____________________

TITLE ____________________

YEARS EXPERIENCE IN TELECOMMUNICATIONS ____________

AVERAGE # YEARS EXPERIENCE IN TELECOMMUNICATIONS (#): 1 ____________

USER INFORMATION

NAME OF USER ____________________

MAJOR FUNCTION OF USER ____________________

SUBCLASS CODE BASED ON MAJOR FUNCTION OF USER (1-13); 2. ____________

LOCATION OF USER HEADQUARTERS (City and State) ____________

REGIONAL CODE BASED ON LOCATION OF HEADQUARTERS (1-9): 3. ____________

NUMBER OF LOCATIONS OF USER FACILITIES (#): 4. ____________

LOCATION OF USER FACILITIES (1-4): 5.
1. Throughout CONUS?
2. Throughout ½ CONUS?
3. Throughout ¼ CONUS?
4. Throughout <¼ CONUS?

TYPE OF LOCATIONS OF FACILITIES (1-3): 6.
1. Urban
2. Rural
3. Mixed

TOTAL ANNUAL SALES OR ASSETS ($): 7. ____________

TOTAL NUMBER OF EMPLOYEES (#): 8. ____________

USER SIZE BASED ON SALES AND/OR EMPLOYEES (1-3): 9.
1. Large
2. Medium
3. Small

GENERAL COMMUNICATIONS

TOTAL ANNUAL COMMUNICATIONS BUDGET ($): 10. $ ____________

PERCENT OF INCREASE (EXCLUDING INFLATION) EXPECTED IN TOTAL ANNUAL COMMUNICATION BUDGET DURING THE NEXT SEVERAL YEARS (%): 11. ____________ %/Yr

PERCENT OF INCREASE EXPECTED IN TOTAL ANNUAL VOLUME OF COMMUNICATION SERVICES USED DURING THE NEXT SEVERAL YEARS (%): 12. ____________ %/Yr

THE MAJOR REASON FOR THIS EXPECTED INCREASE IN VOLUME OF SERVICES IS: 13.
1. Organization will expand.
2. Desire for services will increase
3. ____________

____

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PERCENT OF TOTAL ANNUAL COMMUNICATIONS BUDGET FOR (%):

Intra-organizational communications needs: (14) ________ %

Inter organizational communications needs: (15) ________ %

WOULD YOU USE A GREATER VOLUME OF SERVICES IF COSTS WERE REDUCED? (16) 1. Yes 2. No

IF NO, WHY? ________________________________

____

________________ (17) ________________

IF YES, HOW MUCH MORE WOULD YOU USE IF COSTS WERE:

			USE MORE		
			10%	25%	50%
	(18)	10%	1	2	3
REDUCED BY:	(19)	25%	1	2	3
	(20)	50%	1	2	3

WOULD YOU USE A LESSER VOLUME OF SERVICES IF COSTS WERE INCREASED? (21) 1. Yes 2. No

IF NO, WHY? ________________________________

____

________________ (22) ________________

IF YES, HOW MUCH LESS WOULD YOU USE IF COSTS WERE:

			USE LESS		
			10%	25%	50%
	(23)	10%	1	2	3
INCREASED BY:	(24)	25%	1	2	3
	(25)	50%	1	2	3

WOULD YOU BE WILLING TO PAY MORE IF PERFORMANCE IMPROVED? (26) 1. Yes 2. No

IF NO, WHY? ________________________________

____

________________ (27) ________________

IF YES, WHICH OF THE FOLLOWING AMOUNTS OF TIME IS CLOSEST TO THE AVERAGE OUTAGE TIME PER YEAR FOR SERVICES YOU ARE NOW RECEIVING (28)

1. 1 hr. (.9999 Avail)
2. 4 hr. (.9995 Avail)
3. 8 hr. (.9990 Avail)
4. 44 hr. (.9950 Avail)

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HOW MUCH MORE WOULD YOU PAY TO REDUCE THIS OUTAGE PER YEAR? (HOW MUCH LESS WOULD YOU EXPECT TO PAY IF THIS OUTAGE AMOUNT INCREASED?)

			PAY MORE (LESS) 10%	25%	50%
REDUCE (INCREASE) OUTAGE TO:	29	1 hr.	1	2	3
	30	4 hr.	1	2	3
	31	8 hr.	1	2	3
	32	44 hr.	1	2	3

WOULD YOU ACCEPT A LOWER LEVEL OF PERFORMANCE IF COSTS WERE REDUCED? 33
1. Yes
2. No

IF NO, WHY? ______________________________

____

______________ 34 ______________

IF YES, GO BACK AND ASK QUESTION 28. IF NOT ALREADY ANSWERED. THEN ASK 29 THROUGH 32 AS APPROPRIATE.

WHAT ARE THE FIVE CITIES TO WHICH MOST OF YOUR COMMUNICATION TRAFFIC FLOWS AND WHAT PERCENTAGE OF YOUR TOTAL TRAFFIC IS YOUR TRAFFIC TO EACH CITY?

	FIVE MAJOR CITIES	%	DISTANCE
1.	______________	35 ______	36 ______________
2.	______________	37 ______	38 ______________
3.	______________	39 ______	40 ______________
4.	______________	41 ______	42 ______________
5.	______________	43 ______	44 ______________

WHAT IS THE FASTEST CHANNEL DATA RATE YOU CURRENTLY ARE USING FOR YOUR COMMUNICATIONS SERVICES? 45
1. 2.4 KBPS
2. 4.8 KBPS
3. 9.6 KBPS
4. 56 KBPS
5. 1.5 MBPS
6. 6.3 MBPS

ARE YOUR FACILITIES SUITABLE FOR CUSTOMER PREMISES SERVICES - IE., COULD A SMALL (10 FOOT) EARTH STATION BE PLACED ON YOUR FACILITIES? 46
1. All are
2. Some are
3. None are

IF "1" OR "2", ARE YOU CURRENTLY USING CUSTOMER PREMISES SERVICES 47
1. Yes
2. No

IF YES, WHO IS PROVIDING THESE SERVICES? 48
1. SBS
2. ______________

IF YES, WHICH OF THE FOLLOWING RESULTED:

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SAVED DOLLARS: (49) 1. Yes
2. No

EXPLAIN: (50) ____________________

____

____

BETTER SERVICE? (51) 1. Yes
2. No

EXPLAIN: (52) ____________________

____

____

BETTER PRODUCTIVITY? (53) 1. Yes
2. No

EXPLAIN: (54) ____________________

____

____

IF NO, WHICH OF THE FOLLOWING FEATURES WOULD BE IMPORTANT IN INFLUENCING YOUR USE OF CUSTOMER PREMISES SERVICES:

		Very Important		Somewhat Important		Not Important
(55)	Low cost?	1	2	3	4	5
(56)	Reliability (at least = now)?	1	2	3	4	5
(57)	High data transmission speeds?	1	2	3	4	5
(58)	Video conferencing capability?	1	2	3	4	5
(59)	Solution to local loop problems?	1	2	3	4	5
(60)	Private ownership option?	1	2	3	4	5
(61)	Security of the system?	1	2	3	4	5
(62)	Alternate to telco?	1	2	3	4	5

IF NO, ARE YOU CONSIDERING THE USE OF CUSTOMER PREMISES SERVICES? (63) 1. Yes
2. No

IF YES, WHY? ____

____

____ (64) ____________________

IF YOU ARE NOT NOW CONSIDERING THE USE OF CUSTOMER PREMISES SERVICES, IS IT LIKELY THAT YOU WILL IN THE NEXT FIVE YEARS? (65.) 1. Yes 2. No

WHICH COMMUNICATION SERVICES (I.E., VOICE, DATA, AND VIDEO APPLICATIONS) DO YOU INTENT TO ADD IN THE NEXT FIVE YEARS? (66.) ____________

1. ____________ 2. ____________

3. ____________ 4. ____________

5. ____________ 6. ____________

VOICE COMMUNICATION

WHAT IS YOUR TOTAL ANNUAL BUDGET FOR TELEPHONE COMMUNICATIONS (I.E., PRIVATE LINE SERVICES, WATS, MESSAGE TELEPHONE SERVICE, PROGRAM CHANNEL TRANSMISSION, MOBILE RADIO TELEPHONE)? (67) $ ____________

PERCENT OF INCREASE (EXCLUDING INFLATION) EXPECTED IN TOTAL ANNUAL BUDGET FOR TELEPHONE COMMUNICATIONS DURING THE NEXT SEVERAL YEARS (%)? (68.) ____________ %/Yr

PERCENT OF INCREASE IN TOTAL ANNUAL VOLUME OF TELEPHONE SERVICE USED DURING THE NEXT SEVERAL YEARS (5)? (69.) ____________ %/Yr

DO YOU USE PRIVATE LINE SERVICES? (70) 1. Yes 2. No

DO YOU USE WATS? (71.) 1. Yes 2. No

DO YOU USE DIAL 800 SERVICE? (72.) 1. Yes 2. No

DO YOU USE TELECONFERENCING? (73.) 1. Yes 2. No

DO YOU USE PROGRAM CHANNEL TRANSMISSION, E.G., THE DISSEMINATION OF INFORMATION TO A NUMBER OF RECEIVING STATIONS SIMULTANEOUSLY? (74.) 1. Yes 2. No

DO YOU USE MOBILE RADIO TELEPHONE? (75.) 1. Yes 2. No

WHAT PERCENT OF THESE TELEPHONE SERVICES ARE FOR:

Intra-organizational needs? (76.) ____________ %

Inter-organizational needs? (77.) ____________ %

WHAT TIME OF THE DAY IS (ARE) YOUR BUSY HOUR(S) FOR THESE TELEPHONE SERVICES (HOUR)?

(78) ________ A. M. P. M.

(79) ________ A. M. P. M.

DATA COMMUNICATIONS

WHAT IS YOUR TOTAL ANNUAL BUDGET FOR DATA COMMUNICATIONS (E.G., DATA TRANSFER, ELECTRONIC MAIL, WORD PROCESSING, FACSIMILE, TWX/TELEX, ETC.)

(80) $ ______________

PERCENT OF INCREASE (EXCLUDING INFLATION) EXPECTED IN TOTAL ANNUAL BUDGER FOR DATA COMMUNICATIONS DURING THE NEXT SEVERAL YEARS (%)?

(81) ______________ %/Yr

PERCENT OF INCREASE IN TOTAL ANNUAL VOLUME OF DATA COMMUNICATIONS SERVICES DURING THE NEXT SEVERAL YEARS (%)?

(82) ______________ %/Yr

ARE YOUR DATA PROCESSING OPERATIONS:

(83) 1. Centralized
2. Decentralized

DO YOU USE DATA COMMUNICATIONS TERMINALS FOR:

DATA TRANSFER? (84) 1. Yes 2. No

BATCH PROCESSING? (85) 1. Yes 2. No

DATA ENTRY? (86) 1. Yes 2. No

REMOTE JOB ENTRY? (87) 1. Yes 2. No

INQUIRE/RESPONSE? (88) 1. Yes 2. No

TIME SHARING? (89) 1. Yes 2. No

ADMINISTRATIVE MESSAGES? (90) 1. Yes 2. No

WORD PROCESSING? (91) 1. Yes 2. No

MAILBOX SERVICES? (92) 1. Yes 2. No

DO YOU USE THE FOLLOWING SERVICES:

FACSIMILE? (93) 1. Yes 2. No

TWX AND TELEX? (94) 1. Yes 2. No

MAILGRAM? (95) 1. Yes 2. No

SECURE VOICE? (96) 1. Yes 2. No

MONITORING SERVICES? (97) 1. Yes 2. No

WHAT PERCENT OF THESE DATA COMMUNICATIONS SERVICES ARE FOR:

Intra-organizational needs? (98) ______________ %

Inter-organizational needs? (99) ______________ %

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WHAT TIME OF THE DAY IS (ARE) YOUR BUSY HOUR(S) FOR THESE DATA COMMUNICATION SERVICES (HOUR)?

(100) ________ A. M. P. M.

(101) ________ A. M. P. M.

VIDEO COMMUNICATION

DO YOU USE VIDEO TELECONFERENCING? (102)
1. Yes
2. No

IF SO:

WHAT IS YOUR TOTAL ANNUAL BUDGET FOR VIDEO TELECONFERENCING? (103) $ ________

WHAT PERCENT OF INCREASE (EXCLUDING INFLATION) IS EXPECTED IN TOTAL ANNUAL BUDGET FOR VIDEO TELECONFERENCING DURING THE NEXT SEVERAL YEARS? (104) ________ %/Yr

WHAT PERCENT OF INCREASE IN TOTAL ANNUAL VOLUME OF VIDEO TELECONFERENCING IS EXPECTED DURING THE NEXT SEVERAL YEARS? (105) ________ %/Yr

WHAT IS THE BIT RATE FOR THIS SERVICE? (106) ________ M or KBPS

IS IT ONE-WAY OR TWO-WAY? (107)
1. One-way
2. Two-way

WHAT DO YOU USE VIDEO TELECONFERENCING FOR:

________ (108) ________

________ (109) ________

________ (110) ________

WHY DO YOU USE IT?

________ (111) ________

________ (112) ________

________ (113) ________

PERCENT OF VIDEO TELECONFERENCING FOR:

Intra-organizational needs? (114) ________ %

Inter-organizational needs? (115) ________ %

WHAT TIME OF THE DAY IS (ARE) YOUR BUSY HOUR(S) FOR VIDEO TELECONFERENCING?

(116) ________ A. M. P. M.

(117) ________ A. M. P. M.

TABLE D-2. HIGHLIGHTS OF USER SURVEY

SAMPLE

Class	Business: 61% Government: 25% Institutions: 14%
Subclasses	3% to 25% (Medical, Manufacturing)
Size	Large: 52% Medium: 26% Small: 22%
Region	9 Regions, varied from 4% to 23%
Number of Locations	Range: 1 to 3200 Mean: 215
CONUS Coverage	ALL CONUS: 60% ½ CONUS: 4% ¼ CONUS: 3% ¼ CONUS: 33%
Urban/Rural	Urban: 45% Rural: 11% Both: 44%

BUDGET

1982 - Dollars

Total	Range: $5,000 to $500,000,000;	Mean: $20,020,000
Voice	Range: $5,000 to $300,000,000;	Mean: $15,043,000
Data	Range: $0 to $200,000,000;	Mean: $6,322,000
Video	Range: $0 to $3,000,000;	Mean: $502,000

Growth Rate

Total	Range: -20% to 100%	Mean: 13%
Voice	Range: -20% to 100%	Mean: 11%
Data	Range: -10% to 400%	Mean: 15%
Video	Range: 0% to 300%	Mean: 32%

VOLUME

Growth

Total	Range: -15% to 100%	Mean: 11%
Voice	Range: -10% to 100%	Mean: 9%
Data	Range: -10% to 600%	Mean: 15%
Video	Range: 0% to 600%	Mean: 57%

TABLE D-2. HIGHLIGHTS OF USER SURVEY (Continued)

Reason

Organization Expansion: 26%
More Services: 67%
Both: 7%

PRICE DEMAND PERFORMANCE

Use More if Costs Reduced? Reason No: 71% cost incentive	yes: 61%	no: 39%
Use Less if Costs Increased? Reason No: 81% cost insensitive	yes: 47%	no: 53%
Pay More if Performance Increased? Reason No: 41% limited budget; 44% already satisfactory	yes: 28%	no: 72%
Accept Lower Performance if Costs Reduced? Reason No: 91% current is minimal	yes: 9%	no: 91%

CUSTOMER PREMISE SERVICE

Use

Facilities Suitable?	All: 61%	Some: 30%	None: 9%
Currently Using?	Yes: 11%	No: 89%	
Provider?	SBS: 62%	AMSAT: 38%	
Currently Considering	Yes: 31%	No: 69%	
Consider in Future	Yes: 37%	No: 63%	

Features Influencing Use

Low Cost: 94% (very: 1, 2)
Reliability: 93% (very: 1, 2)
High Data Speed: Mixed
Video Conferencing Capability: Mixed
Local Loop Solution: Mixed
Private Ownership: Mixed
Security: Mixed
Telco Alternate: Mixed

Actual Results of Use

Saved Dollars: 87%
Service Better: 75%
Productivity Better: 67%

TABLE D-2. HIGHLIGHTS OF USER SURVEY (Continued)

NEEDS AND SERVICES

New Delivery/Applications Planned

Satellite Services:	2%	High Speed Services:	4%
Fiber Optics:	2%	Video Teleconferencing	24%
Microwave:	2%	DBS:	7%
SBS:	7%	Videotext:	0%
CPS:	4%	Electronic Mail:	3%
Private Networks:	5%	More Services:	28%
Digital Services	6%	None	6%

Intra-Inter Needs

Total	Intra:	58%	Inter:	42%
Voice	Intra:	57%	Inter:	43%
Data	Intra:	80%	Inter:	20%
Video	Intra:	89%	Inter:	11%

Current Fastest Channel Data Rate

_2.4K	13%
¯4.8K	14%
9.6K	53%
56K	15%
1.5M	4%
6.3M	1%

Peak Hour

Voice	First:	10:00 A. M.	48%
	Second:	2:00 P. M.	51%
Data	First:	Even	37%
	Second:	Even	47%
Video	First:	Even	28%
	Second:	Even	46%

Use Video Teleconferencing

Yes:	15%
No:	85%

SAMPLE SIZE FOR
EACH CLASS AND SUBCLASS OF USERS

QUESTION NO. 2

CLASS/SUBCLASS	FREQ	PCT
BUSINESS		
MANUFACTURING	64	25.3
TRANSPORTATION	17	6.7
UTILITIES	13	5.1
RETAIL	12	4.7
FINANCE	15	5.9
PROFESSIONAL	13	5.1
OTHER	19	7.5
SUBTOTAL	153	60.5
GOVERNMENT		
FEDERAL	27	10.7
STATE	20	7.9
LOCAL	17	6.7
SUBTOTAL	64	25.3
INSTITUTIONS		
EDUCATIONAL	20	7.9
MEDICAL	9	3.6
RELIGIOUS	7	2.8
SUBTOTAL	36	14.2
TOTAL	253	100.0

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TABLE D-3

SAMPLE SIZE FOR
EACH REGION

REGION	QUESTION NO. 3 FREQ	PCT
ME,NH,MA,CT,RI,VT	18	7.1
NY,PA,NJ	39	15.4
DE,MD,WV,VA,NC,SC,GE,FL	58	22.9
KY,TN,MS,AL	18	7.1
MI,WI,IL,IN,OH	42	16.6
ND,SD,MN,IA,NE,KS,MO	23	9.1
TX,OK,AR,LA	19	7.5
MT,ID,WY,UT.CO,AZ,NV.NM	9	3.6
WA,OR,CA	27	10.7
TOTAL	253	100.0

TABLE D-4

SAMPLE SIZE FOR
EACH SIZE OF USERS

QUESTION NO. 9

SIZE	FREQ	PCT
LARGE	133	52.6
MEDIUM	65	25.7
SMALL	55	21.7
TOTAL	253	100.0

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TABLE D-5

LOCATION OF USERS
NUMBER OF LOCATIONS OF USER PREMISES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 4

CLASS/SUBCLASS	FREQ	LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	58	2	1700	232
TRANSPORTATION	15	1	3200	336
UTILITIES	13	7	150	43
RETAIL	12	2	2400	886
FINANCE	12	4	1240	284
PROFESSIONAL	11	3	450	140
OTHER	19	1	1562	146
SUBTOTAL	140	1	3200	267
GOVERNMENT				
FEDERAL	26	1	537	80
STATE	14	20	1000	289
LOCAL	16	1	1600	149
SUBTOTAL	56	1	1600	152
INSTITUTIONS				
EDUCATIONAL	17	1	80	9
MEDICAL	9	1	3050	340
RELIGIOUS	7	1	30	10
SUBTOTAL	33	1	3050	99
TOTAL	229	1	3200	215

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TABLE D-6

LOCATION OF USERS
LOCATION OF USER PREMISES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 5

CLASS/SUBCLASS	FREQ	THRU CONUS PCT	THRU 1/2 CONUS PCT	THRU 1/4 CONUS PCT	THRU < 1/4 CONUS PCT
BUSINESS					
MANUFACTURING	63	88.9	3.2	3.2	4.8
TRANSPORTATION	17	76.5	5.9	5.9	11.8
UTILITIES	13	7.7	0.0	7.7	84.6
RETAIL	10	80.0	10.0	0.0	10.0
FINANCE	14	78.6	7.1	0.0	14.3
PROFESSIONAL	13	92.3	0.0	0.0	7.7
OTHER	18	61.1	16.7	11.1	11.1
SUBTOTAL	148	75.7	5.4	4.1	14.9
GOVERNMENT					
FEDERAL	24	66.7	8.3	0.0	25.0
STATE	18	22.2	0.0	0.0	77.8
LOCAL	12	8.3	0.0	0.0	91.7
SUBTOTAL	54	38.9	3.7	0.0	57.4
INSTITUTIONS					
EDUCATIONAL	18	5.6	0.0	5.6	88.9
MEDICAL	8	12.5	0.0	0.0	87.5
RELIGIOUS	6	83.3	0.0	0.0	16.7
SUBTOTAL	32	21.9	0.0	3.1	75.0
TOTAL	234	59.8	4.3	3.0	32.9

TABLE D-7

LOCATION OF USERS
TYPE OF LOCATION OF USER PREMISES BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 6

CLASS/SUBCLASS	FREQ	URBAN PCT	RURAL PCT	MIXED PCT
BUSINESS				
MANUFACTURING	60	18.3	15.0	66.7
TRANSPORTATION	17	64.7	0.0	35.3
UTILITIES	13	15.4	69.2	15.4
RETAIL	10	50.0	0.0	50.0
FINANCE	15	33.3	0.0	66.7
PROFESSIONAL	13	69.2	7.7	23.1
OTHER	18	50.0	11.1	38.9
SUBTOTAL	146	35.6	14.4	50.0
GOVERNMENT				
FEDERAL	24	54.2	4.2	41.7
STATE	18	16.7	16.7	66.7
LOCAL	17	94.1	0.0	5.9
SUBTOTAL	59	54.2	6.8	39.0
INSTITUTIONS				
EDUCATIONAL	19	73.7	5.3	21.1
MEDICAL	9	66.7	0.0	33.3
RELIGIOUS	6	66.7	0.0	33.3
SUBTOTAL	34	70.6	2.9	26.5
TOTAL	239	45.2	10.9	43.9

TABLE D-8

ANNUAL COMMUNICATIONS BUDGET
TOTAL BUDGET IN DOLLARS (000'S)
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 10

CLASS/SUBCLASS	FREQ	LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	52	180	150000	22138
TRANSPORTATION	15	35	89000	25194
UTILITIES	9	700	13500	4756
RETAIL	10	15	22000	7631
FINANCE	12	300	156200	36225
PROFESSIONAL	10	10	54000	14395
OTHER	16	5	500000	56650
SUBTOTAL	124	5	500000	25268
GOVERNMENT				
FEDERAL	23	61	120000	14944
STATE	17	3300	150000	31629
LOCAL	16	60	43[illegible]00	4460
SUBTOTAL	56	60	150000	17014
INSTITUTIONS				
EDUCATIONAL	17	250	10000	3642
MEDICAL	6	20	2500	1152
RELIGIOUS	5	6	8400	1876
SUBTOTAL	28	6	10000	2793
TOTAL	208	5	500000	20020

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TABLE D-9

PERCENT INCREASE IN ANNUAL COMMUNICATIONS BUDGET
TOTAL BUDGET
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 11

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	56	¯10	50	13
TRANSPORTATION	16	0	30	11
UTILITIES	10	5	25	13
RETAIL	11	7	60	17
FINANCE	15	0	100	20
PROFESSIONAL	13	0	45	15
OTHER	16	0	30	12
SUBTOTAL	137	¯10	100	14
GOVERNMENT				
FEDERAL	22	¯20	25	5
STATE	17	0	20	15
LOCAL	15	0	25	10
SUBTOTAL	54	¯20	25	9
INSTITUTIONS				
EDUCATIONAL	14	5	25	12
MEDICAL	7	5	22	10
RELIGIOUS	6	10	25	15
SUBTOTAL	27	5	25	12
TOTAL	218	¯20	100	13

TABLE D-10

PERCENT OF INCREASE IN ANNUAL VOLUME OF SERVICES
ALL SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 12

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	57	⁻15	100	12
TRANSPORTATION	16	0	30	9
UTILITIES	10	0	35	12
RETAIL	11	5	25	12
FINANCE	15	0	40	15
PROFESSIONAL	13	0	30	15
OTHER	17	0	30	11
SUBTOTAL	139	⁻15	100	12
GOVERNMENT				
FEDERAL	19	⁻10	15	4
STATE	17	0	20	8
LOCAL	15	0	100	10
SUBTOTAL	51	⁻10	100	7
INSTITUTIONS				
EDUCATIONAL	13	5	20	12
MEDICAL	7	0	10	5
RELIGIOUS	6	5	25	11
SUBTOTAL	26	0	25	10
TOTAL	216	⁻15	100	11

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TABLE D-11

REASON FOR EXPECTED INCREASE IN VOLUME
ALL SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 13

CLASS/SUBCLASS	FREQ	ORGANIZATION WILL EXPAND PCT	DESIRE FOR MORE SERVICES PCT	BOTH REASONS PCT
BUSINESS				
MANUFACTURING	53	30.2	58.5	11.3
TRANSPORTATION	14	28.6	64.3	7.1
UTILITIES	10	30.0	70.0	0.0
RETAIL	12	16.7	83.3	0.0
FINANCE	13	30.8	53.8	15.4
PROFESSIONAL	10	40.0	60.0	0.0
OTHER	16	37.5	56.3	6.3
SUBTOTAL	128	30.5	61.7	7.8
GOVERNMENT				
FEDERAL	8	0.0	100.0	0.0
STATE	14	7.1	85.7	7.1
LOCAL	6	0.0	100.0	0.0
SUBTOTAL	28	3.6	92.9	3.6
INSTITUTIONS				
EDUCATIONAL	14	14.3	78.6	7.1
MEDICAL	6	33.3	66.7	0.0
RELIGIOUS	6	66.7	33.3	0.0
SUBTOTAL	26	30.8	65.4	3.8
TOTAL	182	26.4	67.0	6.6

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TABLE D-12

INTRA-ORGANIZATIONAL COMMUNICATIONS NEEDS
ALL SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 14

CLASS/SUBCLASS	FREQ	PERCENT LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	52	20	90	57
TRANSPORTATION	14	15	90	45
UTILITIES	8	60	97	78
RETAIL	9	20	90	65
FINANCE	14	5	90	49
PROFESSIONAL	10	10	95	50
OTHER	15	20	95	54
SUBTOTAL	122	5	97	56
GOVERNMENT				
FEDERAL	17	0	100	56
STATE	14	50	90	71
LOCAL	12	10	95	65
SUBTOTAL	43	0	100	64
INSTITUTIONS				
EDUCATIONAL	15	10	95	54
MEDICAL	9	60	95	74
RELIGIOUS	6	35	95	66
SUBTOTAL	30	10	95	62
TOTAL	195	0	100	58

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TABLE D-13

INTER-ORGANIZATIONAL COMMUNICATIONS NEEDS
ALL SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 15

CLASS/SUBCLASS	FREQ	PERCENT LOW	PERCENT HIGH	PERCENT MEAN
BUSINESS				
MANUFACTURING	51	10	80	44
TRANSPORTATION	14	10	85	55
UTILITIES	8	3	40	22
RETAIL	9	1	80	35
FINANCE	14	10	95	51
PROFESSIONAL	10	5	90	50
OTHER	15	5	80	46
SUBTOTAL	121	1	95	44
GOVERNMENT				
FEDERAL	17	0	100	44
STATE	14	5	50	26
LOCAL	12	5	90	32
SUBTOTAL	43	0	100	35
INSTITUTIONS				
EDUCATIONAL	15	5	90	46
MEDICAL	9	0	40	23
RELIGIOUS	6	1	65	34
SUBTOTAL	30	0	90	37
TOTAL	194	0	100	41

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TABLE D-14

PRICE DEMAND RELATIONSHIP
EFFECT ON DEMAND OF PRICE REDUCTIONS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 16

CLASS/SUBCLASS	FREQ	WOULD YOU USE A GREATER VOLUME OF SERVICES IF COSTS WERE REDUCED YES PCT	NO PCT
BUSINESS			
MANUFACTURING	64	62.5	37.5
TRANSPORTATION	17	82.4	17.6
UTILITIES	13	38.5	61.5
RETAIL	12	50.0	50.0
FINANCE	15	66.7	33.3
PROFESSIONAL	12	66.7	33.3
OTHER	18	77.8	22.2
SUBTOTAL	151	64.2	35.8
GOVERNMENT			
FEDERAL	26	34.6	65.4
STATE	20	55.0	45.0
LOCAL	17	47.1	52.9
SUBTOTAL	63	44.4	55.6
INSTITUTIONS			
EDUCATIONAL	18	77.8	22.2
MEDICAL	9	66.7	33.3
RELIGIOUS	7	71.4	28.6
SUBTOTAL	34	73.5	26.5
TOTAL	248	60.5	39.5

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TABLE D-15

PRICE PERFORMANCE RELATIONSHIP
REASON WOULD NOT USE GREATER VOLUME IF COST REDUCED
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 17

CLASS/SUBCLASS	FREQ	REASONS RELATED TO COST INSENSITIVE PCT	LIMITED BUDGET PCT	COST EFFECTIVENESS PCT
BUSINESS				
MANUFACTURING	16	87.5	12.5	0.0
TRANSPORTATION	1	100.0	0.0	0.0
UTILITIES	3	100.0	0.0	0.0
RETAIL	4	50.0	50.0	0.0
FINANCE	2	100.0	0.0	0.0
PROFESSIONAL	1	0.0	100.0	0.0
OTHER	3	100.0	0.0	0.0
SUBTOTAL	30	83.3	16.7	0.0
GOVERNMENT				
FEDERAL	7	85.7	0.0	14.3
STATE	5	20.0	40.0	40.0
LOCAL	7	85.7	0.0	14.3
SUBTOTAL	19	68.4	10.5	21.1
INSTITUTIONS				
EDUCATIONAL	4	25.0	75.0	0.0
MEDICAL	1	0.0	0.0	100.0
RELIGIOUS	2	50.0	50.0	0.0
SUBTOTAL	7	28.6	57.1	14.3
TOTAL	56	71.4	19.6	8.9

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TABLE D-16

PRICE DEMAND RELATIONSHIP
HOW MUCH MORE WOULD USE IF COST REDUCED 10 PCT
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 18

CLASS/SUBCLASS	FREQ	ADDITIONAL USAGE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	31	90.3	9.7	0.0
TRANSPORTATION	13	100.0	0.0	0.0
UTILITIES	5	100.0	0.0	0.0
RETAIL	6	100.0	0.0	0.0
FINANCE	7	100.0	0.0	0.0
PROFESSIONAL	7	100.0	0.0	0.0
OTHER	13	84.6	15.4	0.0
SUBTOTAL	82	93.9	6.1	0.0
GOVERNMENT				
FEDERAL	8	87.5	12.5	0.0
STATE	10	100.0	0.0	0.0
LOCAL	8	100.0	0.0	0.0
SUBTOTAL	26	96.2	3.8	0.0
INSTITUTIONS				
EDUCATIONAL	12	100.0	0.0	0.0
MEDICAL	6	100.0	0.0	0.0
RELIGIOUS	5	80.0	20.0	0.0
SUBTOTAL	23	95.7	4.3	0.0
TOTAL	131	94.7	5.3	0.0

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TABLE D-17

PRICE DEMAND RELATIONSHIP
HOW MUCH MORE WOULD USE IF COST REDUCED 25 PCT
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 19

CLASS/SUBCLASS	FREQ	ADDITIONAL USAGE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	32	53.1	34.4	12.5
TRANSPORTATION	14	57.1	42.9	0.0
UTILITIES	5	60.0	40.0	0.0
RETAIL	6	66.7	33.3	0.0
FINANCE	7	57.1	42.9	0.0
PROFESSIONAL	7	42.9	57.1	0.0
OTHER	12	50.0	41.7	8.3
SUBTOTAL	83	54.2	39.8	6.0
GOVERNMENT				
FEDERAL	8	12.5	87.5	0.0
STATE	10	80.0	20.0	0.0
LOCAL	8	87.5	12.5	0.0
SUBTOTAL	26	61.5	38.5	0.0
INSTITUTIONS				
EDUCATIONAL	12	41.7	58.3	0.0
MEDICAL	6	50.0	50.0	0.0
RELIGIOUS	5	40.0	60.0	0.0
SUBTOTAL	23	43.5	56.5	0.0
TOTAL	132	53.8	42.4	3.8

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TABLE D-18

PRICE DEMAND RELATIONSHIP
HOW MUCH MORE WOULD USE IF COST REDUCED 50 PCT
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 20

CLASS/SUBCLASS	FREQ	ADDITIONAL USAGE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	31	22.6	51.6	25.8
TRANSPORTATION	14	7.1	64.3	28.6
UTILITIES	5	20.0	40.0	40.0
RETAIL	6	16.7	66.7	16.7
FINANCE	7	14.3	71.4	14.3
PROFESSIONAL	7	28.6	28.6	42.9
OTHER	12	25.0	33.3	41.7
SUBTOTAL	82	19.5	51.2	29.3
GOVERNMENT				
FEDERAL	8	0.0	25.0	75.0
STATE	10	40.0	30.0	30.0
LOCAL	8	50.0	50.0	0.0
SUBTOTAL	26	30.8	34.6	34.6
INSTITUTIONS				
EDUCATIONAL	12	33.3	25.0	41.7
MEDICAL	6	50.0	16.7	33.3
RELIGIOUS	5	0.0	40.0	60.0
SUBTOTAL	23	30.4	26.1	43.5
TOTAL	131	23.7	43.5	32.8

TABLE D-19

C-3

PRICE DEMAND RELATIONSHIP
EFFECT ON DEMAND OF PRICE INCREASES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 21

CLASS/SUBCLASS	FREQ	WOULD YOU USE A LESSER VOLUME OF SERVICES IF COSTS WERE INCREASED YES PCT	NO PCT
BUSINESS			
MANUFACTURING	61	50.8	49.2
TRANSPORTATION	15	40.0	60.0
UTILITIES	12	33.3	66.7
RETAIL	12	50.0	50.0
FINANCE	15	20.0	80.0
PROFESSIONAL	12	25.0	75.0
OTHER	17	64.7	35.3
SUBTOTAL	144	44.4	55.6
GOVERNMENT			
FEDERAL	24	62.5	37.5
STATE	20	60.0	40.0
LOCAL	16	43.8	56.3
SUBTOTAL	60	56.7	43.3
INSTITUTIONS			
EDUCATIONAL	18	44.4	55.6
MEDICAL	9	55.6	44.4
RELIGIOUS	7	14.3	85.7
SUBTOTAL	34	41.2	58.8
TOTAL	238	47.1	52.9

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TABLE D-20

PRICE PERFORMANCE RELATIONSHIP
REASONS WOULD NOT USE LESSER VOLUME IF COSTS INCREASED
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 22

CLASS/SUBCLASS	FREQ	REASONS RELATED TO COST INSENSITIVE PCT	COST EFFECTIVNESS PCT
BUSINESS			
MANUFACTURING	12	91.7	8.3
TRANSPORTATION	5	100.0	0.0
UTILITIES	3	100.0	0.0
RETAIL	4	100.0	0.0
FINANCE	6	83.3	16.7
PROFESSIONAL	4	100.0	0.0
OTHER	4	50.0	50.0
SUBTOTAL	38	89.5	10.5
GOVERNMENT			
FEDERAL	3	66.7	33.3
STATE	1	100.0	0.0
LOCAL	8	62.5	37.5
SUBTOTAL	12	66.7	33.3
INSTITUTIONS			
EDUCATIONAL	7	42.9	57.1
MEDICAL	3	100.0	0.0
RELIGIOUS	4	100.0	0.0
SUBTOTAL	14	71.4	28.6
TOTAL	64	81.3	18.8

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TABLE D-21

PRICE DEMAND RELATIONSHIP
HOW MUCH LESS WOULD USE IF COST INCREASED 10 PCT
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 23

CLASS/SUBCLASS	FREQ	REDUCED USAGE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	29	[illegible]9.7	10.3	0.0
TRANSPORTATION	5	100.0	0.0	0.0
UTILITIES	4	75.0	25.0	0.0
RETAIL	5	100.0	0.0	0.0
FINANCE	2	100.0	0.0	0.0
PROFESSIONAL	4	100.0	0.0	0.0
OTHER	10	90.0	10.0	0.0
SUBTOTAL	59	91.5	8.5	0.0
GOVERNMENT				
FEDERAL	15	100.0	0.0	0.0
STATE	12	100.0	0.0	0.0
LOCAL	8	87.5	12.5	0.0
SUBTOTAL	35	97.1	2.9	0.0
INSTITUTIONS				
EDUCATIONAL	6	100.0	0.0	0.0
MEDICAL	4	100.0	0.0	0.0
RELIGIOUS	1	100.0	0.0	0.0
SUBTOTAL	11	100.0	0.0	0.0
TOTAL	105	94.3	5.7	0.0

TABLE D-22

PRICE DEMAND RELATIONSHIP
HOW MUCH LESS WOULD USE IF COST INCREASED 25 PCT
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 24

CLASS/SUBCLASS	FREQ	REDUCED USAGE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	29	69.0	27.6	3.4
TRANSPORTATION	5	80.0	0.0	20.0
UTILITIES	4	50.0	25.0	25.0
RETAIL	5	60.0	40.0	0.0
FINANCE	2	50.0	50.0	0.0
PROFESSIONAL	4	100.0	0.0	0.0
OTHER	11	54.5	45.5	0.0
SUBTOTAL	60	66.7	28.3	5.0
GOVERNMENT				
FEDERAL	15	20.0	80.0	0.0
STATE	12	83.3	16.7	0.0
LOCAL	8	50.0	50.0	0.0
SUBTOTAL	35	48.6	51.4	0.0
INSTITUTIONS				
EDUCATIONAL	6	50.0	50.0	0.0
MEDICAL	4	75.0	25.0	0.0
RELIGIOUS	1	100.0	0.0	0.0
SUBTOTAL	11	63.6	36.4	0.0
TOTAL	106	60.4	36.8	2.8

TABLE D-23

PRICE DEMAND RELATIONSHIP
HOW MUCH LESS WOULD USE IF COST INCREASED 50 PCT
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 25

CLASS/SUBCLASS	FREQ	REDUCED USAGE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	28	35.7	50.0	14.3
TRANSPORTATION	6	33.3	50.0	16.7
UTILITIES	4	0.0	50.0	50.0
RETAIL	5	20.0	40.0	40.0
FINANCE	2	0.0	100.0	0.0
PROFESSIONAL	4	50.0	50.0	0.0
OTHER	11	18.2	54.5	27.3
SUBTOTAL	60	28.3	51.7	20.0
GOVERNMENT				
FEDERAL	15	6.7	46.7	46.7
STATE	12	41.7	33.3	25.0
LOCAL	8	25.0	50.0	25.0
SUBTOTAL	35	22.9	42.9	34.3
INSTITUTIONS				
EDUCATIONAL	6	33.3	33.3	33.3
MEDICAL	4	50.0	25.0	25.0
RELIGIOUS	1	100.0	0.0	0.0
SUBTOTAL	11	45.5	27.3	27.3
TOTAL	106	28.3	46.2	25.5

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TABLE D-24

PERFORMANCE PRICE RELATIONSHIP
EFFECT OF IMPROVING PERFORMANCE ON AMOUNT WILLING TO PAY
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 26

CLASS/SUBCLASS	FREQ	WOULD YOU BE WILLING TO PAY MORE IF PERFORMANCE IMPROVED YES PCT	NO PCT
BUSINESS			
MANUFACTURING	61	23.0	77.0
TRANSFORTATION	16	43.8	56.3
UTILITIES	12	66.7	33.3
RETAIL	10	10.0	90.0
FINANCE	15	40.0	60.0
PROFESSIONAL	12	16.7	83.3
OTHER	18	22.2	77.8
SUBTOTAL	144	29.2	70.8
GOVERNMENT			
FEDERAL	21	28.6	71.4
STATE	18	22.2	77.8
LOCAL	17	17.6	82.4
SUBTOTAL	56	23.2	76.8
INSTITUTIONS			
EDUCATIONAL	19	26.3	73.7
MEDICAL	9	44.4	55.6
RELIGIOUS	6	33.3	66.7
SUBTOTAL	34	32.4	67.6
TOTAL	234	28.2	71.8

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TABLE D-25

PRICE PERFORMANCE RELATIONSHIP
REASONS WOULD NOT PAY MORE IF PERFORMANCE IMPROVED
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 27

CLASS/SUBCLASS	FREQ	REASONS RELATED TO COST EFFECTIVNESS PCT	LIMITED BUDGET PCT	ALREADY SATISFACTORY PCT
BUSINESS				
MANUFACTURING	20	25.0	20.0	55.0
TRANSPORTATION	6	16.7	50.0	33.3
UTILITIES	1	0.0	0.0	100.0
RETAIL	6	0.0	50.0	50.0
FINANCE	4	0.0	0.0	100.0
PROFESSIONAL	4	25.0	25.0	50.0
OTHER	5	40.0	0.0	60.0
SUBTOTAL	46	19.6	23.9	56.5
GOVERNMENT				
FEDERAL	10	20.0	60.0	20.0
STATE	9	11.1	55.6	33.3
LOCAL	13	15.4	69.2	15.4
SUBTOTAL	32	15.6	62.5	21.9
INSTITUTIONS				
EDUCATIONAL	8	0.0	87.5	12.5
MEDICAL	2	0.0	0.0	100.0
RELIGIOUS	4	0.0	0.0	100.0
SUBTOTAL	14	0.0	50.0	50.0
TOTAL	92	15.2	41.3	43.5

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TABLE D-26

PERFORMANCE INDEX
OUTAGE TIME PER YEAR
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 28

CLASS/SUBCLASS	FREQ	HOURS/AVAILABILITY(AV) LEVELS 1 HR .9999 AV PCT	4 HR .9995 AV PCT	8 HR .9990 AV PCT	44 HR .9950 AV PCT
BUSINESS					
MANUFACTURING	34	11.8	26.5	29.4	32.4
TRANSPORTATION	9	11.1	44.4	11.1	33.3
UTILITIES	8	0.0	12.5	12.5	75.0
RETAIL	2	0.0	50.0	0.0	50.0
FINANCE	8	12.5	0.0	50.0	37.5
PROFESSIONAL	3	0.0	33.3	33.3	33.3
OTHER	6	0.0	16.7	83.3	0.0
SUBTOTAL	70	8.6	24.3	31.4	35.7
GOVERNMENT					
FEDERAL	10	10.0	30.0	40.0	20.0
STATE	2	0.0	50.0	0.0	50.0
LOCAL	6	16.7	16.7	33.3	33.3
SUBTOTAL	18	11.1	27.8	33.3	27.8
INSTITUTIONS					
EDUCATIONAL	11	9.1	0.0	63.6	27.3
MEDICAL	5	0.0	60.0	0.0	40.0
RELIGIOUS	4	25.0	25.0	50.0	0.0
SUBTOTAL	20	10.0	20.0	45.0	25.0
TOTAL	108	9.3	24.1	34.3	32.4

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TABLE D-27

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH MORE WOULD PAY IF OUTAGE REDUCED FROM 4 TO 1 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	ACCEPTABLE COST INCREASE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	1	100.0	0.0	0.0
TRANSPORTATION	4	100.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	1	100.0	0.0	0.0
SUBTOTAL	6	100.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	1	100.0	0.0	0.0
LOCAL	1	100.0	0.0	0.0
SUBTOTAL	2	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	1	100.0	0.0	0.0
RELIGIOUS	1	100.0	0.0	0.0
SUBTOTAL	2	100.0	0.0	0.0
TOTAL	10	100.0	0.0	0.0

TABLE D-28

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH MORE WOULD PAY IF OUTAGE REDUCED FROM 8 TO 4 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	ACCEPTABLE COST INCREASE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	3	100.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	1	100.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	3	100.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	1	100.0	0.0	0.0
SUBTOTAL	8	100.0	0.0	0.0
GOVERNMENT				
FEDERAL	1	100.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	1	100.0	0.0	0.0
SUBTOTAL	2	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	3	100.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	1	100.0	0.0	0.0
SUBTOTAL	4	100.0	0.0	0.0
TOTAL	14	100.0	0.0	0.0

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TABLE D-29

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH MORE WOULD PAY IF OUTAGE REDUCED FROM 8 TO 1 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	ACCEPTABLE COST INCREASE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	3	100.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	1	100.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	3	66.7	33.3	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	1	100.0	0.0	0.0
SUBTOTAL	8	87.5	12.5	0.0
GOVERNMENT				
FEDERAL	1	100.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	1	100.0	0.0	0.0
SUBTOTAL	2	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	3	100.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	1	100.0	0.0	0.0
SUBTOTAL	4	100.0	0.0	0.0
TOTAL	14	92.9	7.1	0.0

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TABLE D-30

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH MORE WOULD PAY IF OUTAGE REDUCED FROM 44 TO 8 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	ACCEPTABLE COST INCREASE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	1	100.0	0.0	0.0
TRANSPORTATION	1	100.0	0.0	0.0
UTILITIES	5	100.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	1	100.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	8	100.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	1	100.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	1	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	1	0.0	100.0	0.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
TOTAL	10	90.0	10.0	0.0

TABLE D-31

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH MORE WOULD PAY IF OUTAGE REDUCED FROM 44 TO 4 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	ACCEPTABLE COST INCREASE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	1	100.0	0.0	0.0
TRANSPORTATION	1	100.0	0.0	0.0
UTILITIES	5	100.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	7	100.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	1	100.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	1	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	1	0.0	100.0	0.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
TOTAL	9	88.9	11.1	0.0

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TABLE D-32

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH MORE WOULD PAY IF OUTAGE REDUCED FROM 44 TO 1 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	ACCEPTABLE COST INCREASE 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	1	100.0	0.0	0.0
TRANSPORTATION	1	100.0	0.0	0.0
UTILITIES	5	80.0	20.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	7	85.7	14.3	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	1	100.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	1	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	1	0.0	100.0	0.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
TOTAL	9	77.8	22.2	0.0

TABLE D-33

PERFORMANCE PRICE RELATIONSHIP
EFFECT OF REDUCING PERFORMANCE ON AMOUNT WILLING TO PAY
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 33

CLASS/SUBCLASS	FREQ	WOULD YOU ACCEPT A LOWER LEVEL OF PERFORMANCE IF COSTS WERE REDUCED YES PCT	NO PCT
BUSINESS			
MANUFACTURING	55	12.7	87.3
TRANSPORTATION	17	5.9	94.1
UTILITIES	11	0.0	100.0
RETAIL	11	0.0	100.0
FINANCE	14	28.6	71.4
PROFESSIONAL	11	0.0	100.0
OTHER	16	0.0	100.0
SUBTOTAL	135	8.9	91.1
GOVERNMENT			
FEDERAL	20	10.0	90.0
STATE	18	5.6	94.4
LOCAL	16	6.3	93.8
SUBTOTAL	54	7.4	92.6
INSTITUTIONS			
EDUCATIONAL	17	0.0	100.0
MEDICAL	7	28.6	71.4
RELIGIOUS	7	14.3	85.7
SUBTOTAL	31	9.7	90.3
TOTAL	220	8.6	91.4

TABLE D-34

PRICE PERFORMANCE RELATIONSHIP
REASONS WOULD NOT ACCEPT LOWER PERFORMANCE IF COSTS REDUCED
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 34

CLASS/SUBCLASS	FREQ	REASONS RELATED TO CURRENT IS MINIMAL PCT	COST EFFECTIVNESS PCT	OTHER PCT
BUSINESS				
MANUFACTURING	18	100.0	0.0	
TRANSPORTATION	7	85.7	14.3	
UTILITIES	2	50.0	50.0	
RETAIL	4	100.0	0.0	
FINANCE	5	60.0	40.0	
PROFESSIONAL	7	100.0	0.0	
OTHER	7	57.1	42.9	
SUBTOTAL	50	86.0	14.0	
GOVERNMENT				
FEDERAL	8	100.0	0.0	
STATE	12	91.7	8.3	
LOCAL	10	100.0	0.0	
SUBTOTAL	30	96.7	3.3	
INSTITUTIONS				
EDUCATIONAL	9	88.9	11.1	
MEDICAL	3	100.0	0.0	
RELIGIOUS	3	100.0	0.0	
SUBTOTAL	15	93.3	6.7	
TOTAL	95	90.5	9.5	

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TABLE D-35

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH LESS EXPECT TO PAY IF OUTAGE INCREASED FROM 1 TO 4 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	EXPECTED COST REDUCTION 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	0	0.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	1	0.0	100.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
TOTAL	1	0.0	100.0	0.0

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TABLE D-36

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH LESS EXPECT TO PAY IF OUTAGE INCREASED FROM 1 TO 8 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	EXPECTED COST REDUCTION 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	0	0.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	1	0.0	100.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
TOTAL	1	0.0	100.0	0.0

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TABLE D-37

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH LESS EXPECT TO PAY IF OUTAGE INCREASED FROM 1 TO 44 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	EXPECTED COST REDUCTION 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	0	0.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	1	0.0	100.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
TOTAL	1	0.0	100.0	0.0

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TABLE D-38

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH LESS EXPECT TO PAY IF OUTAGE INCREASED FROM 4 TO 8 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	EXPECTED COST REDUCTION 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	1	100.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	1	100.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
TOTAL	1	100.0	0.0	0.0

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TABLE D-39

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH LESS EXPECT TO PAY IF OUTAGE INCREASED FROM 4 TO 44 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	EXPECTED COST REDUCTION 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	1	0.0	100.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	1	0.0	100.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
TOTAL	1	0.0	100.0	0.0

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TABLE D-40

PRICE PERFORMANCE RELATIONSHIP
HOW MUCH LESS EXPECT TO PAY IF OUTAGE INCREASED FROM 8 TO 44 HRS
BY CLASS AND SUBCLASS OF USERS

CLASS/SUBCLASS	FREQ	EXPECTED COST REDUCTION 10 PCT PCT	25 PCT PCT	50 PCT PCT
BUSINESS				
MANUFACTURING	0	0.0	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	0	0.0	0.0	0.0
PROFESSIONAL	0	0.0	0.0	0.0
OTHER	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	0	0.0	0.0	0.0
LOCAL	1	100.0	0.0	0.0
SUBTOTAL	1	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0
TOTAL	1	100.0	0.0	0.0

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TABLE D-41

DISTRIBUTION OF TRAFFIC
BY DISTANCE
DOLLARS IN 1000'S

NUMBER OF USERS FOR WHICH TRAFFIC AND DISTANCE INFO AVAILABLE: 194
TOTAL COMMUNICATION DOLLARS FOR THESE USERS: 4068888
TOTAL COMMUNICATION DOLLARS FOR MAJOR ROUTES OF THESE USERS: 1711026.77
TOTAL NUMBER OF THESE MAJOR ROUTES: 861

MILEAGE BANDS	PCT DIST DOLLARS	PCT ROUTES
≤40	7.32	8.23
41 - 150	15.10	10.31
151 - 500	27.53	27.67
501 - 1000	22.07	16.68
1001 - 2100	16.38	26.58
>2100	11.61	10.53

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TABLE D-42

USE OF CPS
CURENT FASTEST CHANNEL DATA RATE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 45

CLASS/SUBCLASS	FREQ	≤2.4K PCT	4.8K PCT	9.6K PCT	56K PCT	1.5M PCT	6.3M PCT
		DATA RATES (BPS)					
BUSINESS							
MANUFACTURING	61	8.2	9.8	52.5	26.2	3.3	0.0
TRANSPORTATION	16	25.0	0.0	56.3	12.5	6.3	0.0
UTILITIES	11	9.1	27.3	63.6	0.0	0.0	0.0
RETAIL	10	0.0	0.0	80.0	20.0	0.0	0.0
FINANCE	15	13.3	13.3	26.7	33.3	13.3	0.0
PROFESSIONAL	10	10.0	0.0	60.0	10.0	10.0	10.0
OTHER	13	7.7	15.4	61.5	15.4	0.0	0.0
SUBTOTAL	136	10.3	9.6	54.4	20.6	4.4	0.7
GOVERNMENT							
FEDERAL	20	15.0	35.0	35.0	10.0	5.0	0.0
STATE	19	15.8	21.1	42.1	21.1	0.0	0.0
LOCAL	13	7.7	23.1	69.2	0.0	0.0	0.0
SUBTOTAL	52	13.5	26.9	46.2	11.5	1.9	0.0
INSTITUTIONS							
EDUCATIONAL	19	15.8	15.8	63.2	0.0	5.3	0.0
MEDICAL	9	33.3	11.1	55.6	0.0	0.0	0.0
RELIGIOUS	5	40.0	0.0	60.0	0.0	0.0	0.0
SUBTOTAL	33	24.2	12.1	60.6	0.0	3.0	0.0
TOTAL	221	13.1	14.0	53.4	15.4	3.6	0.5

TABLE D-43

USE OF CPS
SUITABILITY OF FACILITIES FOR 10 FT EARTH STATION
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 46

CLASS/SUBCLASS	FREQ	NUMBER SUITABLE ALL PCT	SOME PCT	NONE PCT
BUSINESS				
MANUFACTURING	59	67.8	25.4	6.8
TRANSPORTATION	16	37.5	62.5	0.0
UTILITIES	13	92.3	7.7	0.0
RETAIL	12	58.3	41.7	0.0
FINANCE	15	33.3	66.7	0.0
PROFESSIONAL	13	53.8	23.1	23.1
OTHER	17	58.8	17.6	23.5
SUBTOTAL	145	60.0	32.4	7.6
GOVERNMENT				
FEDERAL	23	52.2	26.1	21.7
STATE	17	47.1	52.9	0.0
LOCAL	17	88.2	11.8	0.0
SUBTOTAL	57	61.4	29.8	8.8
INSTITUTIONS				
EDUCATIONAL	18	61.1	27.8	11.1
MEDICAL	9	55.6	11.1	33.3
RELIGIOUS	7	71.4	28.6	0.0
SUBTOTAL	34	61.8	23.5	14.7
TOTAL	236	60.6	30.5	8.9

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TABLE D-44

USE OF CPS
CURRENTLY USING CPS SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 47

CLASS/SUBCLASS	FREQ	USING CPS YES PCT	NO PCT
BUSINESS			
MANUFACTURING	56	14.3	85.7
TRANSPORTATION	16	25.0	75.0
UTILITIES	13	7.7	92.3
RETAIL	10	0.0	100.0
FINANCE	14	14.3	85.7
PROFESSIONAL	10	20.0	80.0
OTHER	15	26.7	73.3
SUBTOTAL	134	15.7	84.3
GOVERNMENT			
FEDERAL	20	0.0	100.0
STATE	20	5.0	95.0
LOCAL	17	0.0	100.0
SUBTOTAL	57	1.8	98.2
INSTITUTIONS			
EDUCATIONAL	14	7.1	92.9
MEDICAL	7	14.3	85.7
RELIGIOUS	7	14.3	85.7
SUBTOTAL	28	10.7	89.3
TOTAL	219	11.4	88.6

TABLE D-45

USE OF CPS
PROVIDER OF CPS SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 48

CLASS/SUBCLASS	FREQ	PROVIDER SBS PCT	PROVIDER AMSAT PCT
BUSINESS			
MANUFACTURING	7	57.1	42.9
TRANSPORTATION	4	75.0	25.0
UTILITIES	1	100.0	0.0
RETAIL	0	0.0	0.0
FINANCE	1	100.0	0.0
PROFESSIONAL	2	0.0	100.0
OTHER	4	75.0	25.0
SUBTOTAL	19	63.2	36.8
GOVERNMENT			
FEDERAL	0	0.0	0.0
STATE	1	100.0	0.0
LOCAL	0	0.0	0.0
SUBTOTAL	1	100.0	0.0
INSTITUTIONS			
EDUCATIONAL	0	0.0	0.0
MEDICAL	0	0.0	0.0
RELIGIOUS	1	0.0	100.0
SUBTOTAL	1	0.0	100.0
TOTAL	21	61.9	38.1

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TABLE D-46

USE OF CPS
DOLLAR SAVINGS AS A RESULT OF USE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 49

CLASS/SUBCLASS	FREQ	SAVED DOLLARS YES PCT	NO PCT
BUSINESS			
MANUFACTURING	8	100.0	0.0
TRANSPORTATION	4	75.0	25.0
UTILITIES	1	100.0	0.0
RETAIL	1	100.0	0.0
FINANCE	1	100.0	0.0
PROFESSIONAL	2	100.0	0.0
OTHER	3	66.7	33.3
SUBTOTAL	20	90.0	10.0
GOVERNMENT			
FEDERAL	0	0.0	0.0
STATE	1	100.0	0.0
LOCAL	0	0.0	0.0
SUBTOTAL	1	100.0	0.0
INSTITUTIONS			
EDUCATIONAL	0	0.0	0.0
MEDICAL	1	0.0	100.0
RELIGIOUS	1	100.0	0.0
SUBTOTAL	2	50.0	50.0
TOTAL	23	87.0	13.0

TABLE D-47

USE OF CPS
BETTER SERVICE AS A RESULT OF USE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 51

CLASS/SUBCLASS	FREQ	BETTER SERVICE YES PCT	BETTER SERVICE NO PCT
BUSINESS			
MANUFACTURING	8	87.5	12.5
TRANSPORTATION	3	66.7	33.3
UTILITIES	0	0.0	0.0
RETAIL	1	100.0	0.0
FINANCE	2	100.0	0.0
PROFESSIONAL	2	50.0	50.0
OTHER	2	50.0	50.0
SUBTOTAL	18	77.8	22.2
GOVERNMENT			
FEDERAL	0	0.0	0.0
STATE	1	0.0	100.0
LOCAL	0	0.0	0.0
SUBTOTAL	1	0.0	100.0
INSTITUTIONS			
EDUCATIONAL	0	0.0	0.0
MEDICAL	1	100.0	0.0
RELIGIOUS	0	0.0	0.0
SUBTOTAL	1	100.0	0.0
TOTAL	20	75.0	25.0

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TABLE D-48

USE OF CPS
BETTER PRODUCTIVITY AS A RESULT OF USE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 53

CLASS/SUBCLASS	FREQ	BETTER PRODUCTIVITY YES PCT	NO PCT
BUSINESS			
MANUFACTURING	8	75.0	25.0
TRANSPORTATION	4	50.0	50.0
UTILITIES	0	0.0	0.0
RETAIL	1	100.0	0.0
FINANCE	2	100.0	0.0
PROFESSIONAL	2	50.0	50.0
OTHER	2	50.0	50.0
SUBTOTAL	19	68.4	31.6
GOVERNMENT			
FEDERAL	0	0.0	0.0
STATE	1	0.0	100.0
LOCAL	0	0.0	0.0
SUBTOTAL	1	0.0	100.0
INSTITUTIONS			
EDUCATIONAL	0	0.0	0.0
MEDICAL	1	100.0	0.0
RELIGIOUS	0	0.0	0.0
SUBTOTAL	1	100.0	0.0
TOTAL	21	66.7	33.3

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TABLE D-49

FEATURES INFLUENCING USE OF CPS
LOW COST
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 55

		IMPORTANCE				
		VERY ←				→ NOT
		1	2	3	4	5
CLASS/SUBCLASS	FREQ	PCT	PCT	PCT	PCT	PCT
BUSINESS						
MANUFACTURING	62	72.6	21.0	6.5	0.0	0.0
TRANSPORTATION	15	73.3	26.7	0.0	0.0	0.0
UTILITIES	13	69.2	30.8	0.0	0.0	0.0
RETAIL	12	58.3	33.3	8.3	0.0	0.0
FINANCE	14	57.1	42.9	0.0	0.0	0.0
PROFESSIONAL	11	81.8	9.1	9.1	0.0	0.0
OTHER	17	47.1	29.4	23.5	0.0	0.0
SUBTOTAL	144	67.4	25.7	6.9	0.0	0.0
GOVERNMENT						
FEDERAL	22	90.9	9.1	0.0	0.0	0.0
STATE	19	100.0	0.0	0.0	0.0	0.0
LOCAL	16	81.3	18.8	0.0	0.0	0.0
SUBTOTAL	57	91.2	8.8	0.0	0.0	0.0
INSTITUTIONS						
EDUCATIONAL	19	63.2	21.1	5.3	10.5	0.0
MEDICAL	8	75.0	25.0	0.0	0.0	0.0
RELIGIOUS	7	57.1	42.9	0.0	0.0	0.0
SUBTOTAL	34	64.7	26.5	2.9	5.9	0.0
TOTAL	235	72.8	21.7	4.7	0.9	0.0

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TABLE D-50

FEATURES INFLUENCING USE OF CPS
RELIABILITY (AT LEAST = NOW)
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 56

CLASS/SUBCLASS	FREQ	IMPORTANCE VERY 1 PCT	2 PCT	3 PCT	4 PCT	NOT 5 PCT
BUSINESS						
MANUFACTURING	62	72.6	19.4	4.8	3.2	0.0
TRANSPORTATION	15	80.0	20.0	0.0	0.0	0.0
UTILITIES	13	61.5	38.5	0.0	0.0	0.0
RETAIL	12	66.7	25.0	0.0	8.3	0.0
FINANCE	14	71.4	14.3	14.3	0.0	0.0
PROFESSIONAL	11	81.8	9.1	9.1	0.0	0.0
OTHER	17	82.4	5.9	5.9	5.9	0.0
SUBTOTAL	144	73.6	18.8	4.9	2.8	0.0
GOVERNMENT						
FEDERAL	22	81.8	13.6	4.5	0.0	0.0
STATE	19	68.4	26.3	5.3	0.0	0.0
LOCAL	15	86.7	13.3	0.0	0.0	0.0
SUBTOTAL	56	78.6	17.9	3.6	0.0	0.0
INSTITUTIONS						
EDUCATIONAL	19	84.2	10.5	0.0	5.3	0.0
MEDICAL	8	62.5	25.0	12.5	0.0	0.0
RELIGIOUS	7	85.7	14.3	0.0	0.0	0.0
SUBTOTAL	34	79.4	14.7	2.9	2.9	0.0
TOTAL	234	75.6	17.9	4.3	2.1	0.0

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TABLE D-51

FEATURES INFLUENCING USE OF CPS
HIGH DATA TRANSMISSION SPEEDS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 57

		IMPORTANCE				
		VERY ←				→ NOT
CLASS/SUBCLASS	FREQ	1 PCT	2 PCT	3 PCT	4 PCT	5 PCT
BUSINESS						
MANUFACTURING	60	16.7	31.7	35.0	10.0	6.7
TRANSPORTATION	15	13.3	26.7	46.7	6.7	6.7
UTILITIES	13	0.0	46.2	23.1	23.1	7.7
RETAIL	12	0.0	25.0	33.3	33.3	8.3
FINANCE	13	30.8	15.4	30.8	23.1	0.0
PROFESSIONAL	11	9.1	54.5	36.4	0.0	0.0
OTHER	17	5.9	35.3	35.3	11.8	11.8
SUBTOTAL	141	12.8	32.6	34.8	13.5	6.4
GOVERNMENT						
FEDERAL	20	20.0	10.0	40.0	25.0	5.0
STATE	19	10.5	31.6	42.1	15.8	0.0
LOCAL	13	7.7	46.2	23.1	7.7	15.4
SUBTOTAL	52	13.5	26.9	36.5	17.3	5.8
INSTITUTIONS						
EDUCATIONAL	19	15.8	36.8	26.3	21.1	0.0
MEDICAL	8	0.0	50.0	12.5	37.5	0.0
RELIGIOUS	7	0.0	0.0	42.9	28.6	28.6
SUBTOTAL	34	8.8	32.4	26.5	26.5	5.9
TOTAL	227	12.3	31.3	33.9	16.3	6.2

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TABLE D-52

FEATURES INFLUENCING USE OF CPS
VIDEO CONFERENCING CAPABILITY
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 58

CLASS/SUBCLASS	FREQ	IMPORTANCE VERY → 1 PCT	2 PCT	3 PCT	4 PCT	→ NOT 5 PCT
BUSINESS						
MANUFACTURING	61	6.6	16.4	32.8	27.9	16.4
TRANSPORTATION	15	0.0	0.0	13.3	53.3	33.3
UTILITIES	12	0.0	0.0	8.3	66.7	25.0
RETAIL	12	8.3	16.7	33.3	8.3	33.3
FINANCE	13	0.0	7.7	30.8	46.2	15.4
PROFESSIONAL	11	0.0	9.1	36.4	45.5	9.1
OTHER	17	5.9	17.6	23.5	35.3	17.6
SUBTOTAL	141	4.3	12.1	27.7	36.2	19.9
GOVERNMENT						
FEDERAL	21	0.0	4.8	23.8	33.3	38.1
STATE	19	10.5	15.8	26.3	21.1	26.3
LOCAL	15	0.0	13.3	33.3	13.3	40.0
SUBTOTAL	55	3.6	10.9	27.3	23.6	34.5
INSTITUTIONS						
EDUCATIONAL	18	0.0	27.8	22.2	38.9	11.1
MEDICAL	7	14.3	42.9	14.3	14.3	14.3
RELIGIOUS	7	0.0	42.9	14.3	28.6	14.3
SUBTOTAL	32	3.1	34.4	18.8	31.3	12.5
TOTAL	228	3.9	14.9	26.3	32.5	22.4

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TABLE D-53

FEATURES INFLUENCING USE OF CPS
SOLUTION TO LOCAL LOOP PROBLEMS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 59

		IMPORTANCE				
		VERY →				→NOT
CLASS/SUBCLASS	FREQ	1 PCT	2 PCT	3 PCT	4 PCT	5 PCT
BUSINESS						
MANUFACTURING	61	3.3	16.4	31.1	34.4	14.8
TRANSPORTATION	14	0.0	7.1	21.4	50.0	21.4
UTILITIES	13	0.0	7.7	23.1	46.2	23.1
RETAIL	12	8.3	0.0	16.7	33.3	41.7
FINANCE	13	0.0	15.4	15.4	53.8	15.4
PROFESSIONAL	11	9.1	9.1	36.4	36.4	9.1
OTHER	17	0.0	5.9	23.5	29.4	41.2
SUBTOTAL	141	2.8	11.3	26.2	38.3	21.3
GOVERNMENT						
FEDERAL	21	9.5	9.5	19.0	28.6	33.3
STATE	19	10.5	10.5	42.1	26.3	10.5
LOCAL	15	6.7	0.0	0.0	6.7	86.7
SUBTOTAL	55	9.1	7.3	21.8	21.8	40.0
INSTITUTIONS						
EDUCATIONAL	19	5.3	10.5	21.1	26.3	36.8
MEDICAL	6	16.7	0.0	0.0	33.3	50.0
RELIGIOUS	7	0.0	0.0	0.0	28.6	71.4
SUBTOTAL	32	6.3	6.3	12.5	28.1	46.9
TOTAL	228	4.8	9.6	23.2	32.9	29.4

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TABLE D-54

FEATURES INFLUENCING USE OF CPS
PRIVATE OWNERSHIP OPTION
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 60

		IMPORTANCE				
		VERY ←				→NOT
CLASS/SUBCLASS	FREQ	1 PCT	2 PCT	3 PCT	4 PCT	5 PCT
BUSINESS						
MANUFACTURING	61	8.2	27.9	29.5	26.2	8.2
TRANSPORTATION	15	0.0	26.7	26.7	33.3	13.3
UTILITIES	13	15.4	46.2	7.7	23.1	7.7
RETAIL	12	0.0	8.3	41.7	33.3	16.7
FINANCE	13	0.0	15.4	69.2	15.4	0.0
PROFESSIONAL	11	9.1	9.1	45.5	27.3	9.1
OTHER	17	0.0	17.6	17.6	23.5	41.2
SUBTOTAL	142	5.6	23.9	31.7	26.1	12.7
GOVERNMENT						
FEDERAL	22	0.0	0.0	31.8	22.7	45.5
STATE	19	10.5	10.5	57.9	21.1	0.0
LOCAL	16	12.5	18.8	6.3	50.0	12.5
SUBTOTAL	57	7.0	8.8	33.3	29.8	21.1
INSTITUTIONS						
EDUCATIONAL	19	15.8	21.1	21.1	31.6	10.5
MEDICAL	8	25.0	12.5	25.0	0.0	37.5
RELIGIOUS	7	0.0	14.3	14.3	0.0	71.4
SUBTOTAL	34	14.7	17.6	20.6	17.6	29.4
TOTAL	233	7.3	19.3	30.5	25.8	17.2

TABLE D-55

FEATURES INFLUENCING USE OF CPS
SECURITY OF THE SYSTEM
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 61

		IMPORTANCE				
		VERY ←				→ NOT
CLASS/SUBCLASS	FREQ	1 PCT	2 PCT	3 PCT	4 PCT	5 PCT
BUSINESS						
MANUFACTURING	61	23.0	29.5	29.5	13.1	4.9
TRANSPORTATION	15	6.7	33.3	26.7	26.7	6.7
UTILITIES	12	25.0	25.0	8.3	33.3	8.3
RETAIL	12	0.0	50.0	16.7	8.3	25.0
FINANCE	13	46.2	23.1	23.1	0.0	7.7
PROFESSIONAL	11	18.2	36.4	36.4	9.1	0.0
OTHER	17	0.0	41.2	23.5	11.8	23.5
SUBTOTAL	141	18.4	32.6	25.5	14.2	9.2
GOVERNMENT						
FEDERAL	22	31.8	18.2	22.7	22.7	4.5
STATE	18	5.6	33.3	44.4	16.7	0.0
LOCAL	14	0.0	7.1	64.3	21.4	7.1
SUBTOTAL	54	14.8	20.4	40.7	20.4	3.7
INSTITUTIONS						
EDUCATIONAL	19	31.6	10.5	15.8	31.6	10.5
MEDICAL	8	0.0	37.5	50.0	12.5	0.0
RELIGIOUS	7	0.0	0.0	28.6	28.6	42.9
SUBTOTAL	34	17.6	14.7	26.5	26.5	14.7
TOTAL	229	17.5	27.1	29.3	17.5	8.7

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TABLE D-56

FEATURES INFLUENCING USE OF CPS
ALTERNATE TO TELCO
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 62

CLASS/SUBCLASS	FREQ	VERY 1 PCT	2 PCT	3 PCT	4 PCT	NOT 5 PCT
		IMPORTANCE				
BUSINESS						
MANUFACTURING	60	20.0	31.7	20.0	18.3	10.0
TRANSPORTATION	15	6.7	26.7	26.7	33.3	6.7
UTILITIES	12	8.3	41.7	8.3	33.3	8.3
RETAIL	12	0.0	16.7	25.0	25.0	33.3
FINANCE	13	7.7	15.4	38.5	30.8	7.7
PROFESSIONAL	11	9.1	27.3	36.4	27.3	0.0
OTHER	16	6.3	18.8	12.5	25.0	37.5
SUBTOTAL	139	12.2	27.3	22.3	24.5	13.7
GOVERNMENT						
FEDERAL	22	9.1	31.8	18.2	31.8	9.1
STATE	18	16.7	16.7	22.2	27.8	16.7
LOCAL	13	0.0	38.5	7.7	23.1	30.8
SUBTOTAL	53	9.4	28.3	17.0	28.3	17.0
INSTITUTIONS						
EDUCATIONAL	19	5.3	15.8	36.8	26.3	15.8
MEDICAL	8	25.0	12.5	25.0	37.5	0.0
RELIGIOUS	7	0.0	0.0	14.3	28.6	57.1
SUBTOTAL	34	8.8	11.8	29.4	29.4	20.6
TOTAL	226	11.1	25.2	22.1	26.1	15.5

TABLE D-57

USE OF CPS
CURRENTLY CONSIDERING CPS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 63

CLASS/SUBCLASS	FREQ	CONSIDERING USE YES PCT	NO PCT
BUSINESS			
MANUFACTURING	56	37.5	62.5
TRANSPORTATION	13	30.8	69.2
UTILITIES	12	50.0	50.0
RETAIL	12	16.7	83.3
FINANCE	15	60.0	40.0
PROFESSIONAL	11	27.3	72.7
OTHER	14	50.0	50.0
SUBTOTAL	133	39.1	60.9
GOVERNMENT			
FEDERAL	23	17.4	82.6
STATE	17	23.5	76.5
LOCAL	16	12.5	87.5
SUBTOTAL	56	17.9	82.1
INSTITUTIONS			
EDUCATIONAL	17	17.6	82.4
MEDICAL	7	28.6	71.4
RELIGIOUS	6	16.7	83.3
SUBTOTAL	30	20.0	80.0
TOTAL	219	31.1	68.9

TABLE D-58

USE OF CPS
REASONS CURRENTLY CONSIDERING USE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 64

CLASS/SUBCLASS	FREQ	REASONS TECHNOLOGY HELPFUL PCT	IMPROVED SERVICES PCT	CUT COSTS PCT
BUSINESS				
MANUFACTURING	9	0.0	22.2	77.8
TRANSPORTATION	3	0.0	33.3	66.7
UTILITIES	2	50.0	50.0	0.0
RETAIL	2	0.0	50.0	50.0
FINANCE	8	0.0	37.5	62.5
PROFESSIONAL	2	0.0	0.0	100.0
OTHER	4	25.0	25.0	50.0
SUBTOTAL	30	6.7	30.0	63.3
GOVERNMENT				
FEDERAL	2	50.0	0.0	50.0
STATE	4	0.0	25.0	75.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	6	16.7	16.7	66.7
INSTITUTIONS				
EDUCATIONAL	3	0.0	33.3	66.7
MEDICAL	2	50.0	0.0	50.0
RELIGIOUS	0	0.0	0.0	0.0
SUBTOTAL	5	20.0	20.0	60.0
TOTAL	41	9.8	26.8	63.4

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TABLE D-59

USE OF CPS
FUTURE CONSIDERATION OF CPS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 65

CLASS/SUBCLASS	FREQ	WILL CONSIDER USE YES PCT	NO PCT
BUSINESS			
MANUFACTURING	34	44.1	55.9
TRANSPORTATION	9	44.4	55.6
UTILITIES	6	16.7	83.3
RETAIL	10	50.0	50.0
FINANCE	6	50.0	50.0
PROFESSIONAL	8	37.5	62.5
OTHER	7	14.3	85.7
SUBTOTAL	80	40.0	60.0
GOVERNMENT			
FEDERAL	18	27.8	72.2
STATE	12	33.3	66.7
LOCAL	14	28.6	71.4
SUBTOTAL	44	29.5	70.5
INSTITUTIONS			
EDUCATIONAL	14	35.7	64.3
MEDICAL	4	75.0	25.0
RELIGIOUS	5	40.0	60.0
SUBTOTAL	23	43.5	56.5
TOTAL	147	37.4	62.6

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TABLE D-60

TABLE D-61

FUTURE PLANS
EXPECTED DELIVERY MODES/APPLICATIONS TO BE ADDED IN FUTURE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 66

CLASS/SUBCLASS	FREQ	NEW SERVICE: SAT SVCS PCT	FIBER OPTICS PCT	MICRO WAVE PCT	SBS PCT	CPS PCT	PRIV NTWKS PCT	DIG SVCS PCT	HSPD SVCS PCT	VIDEO TELCON PCT	DBS PCT	VIDEO TEXT PCT	ELECT MAIL PCT	MORE SVCS PCT	NONE PCT
BUSINESS															
MANUFACTURING	64	1.6	3.1	1.6	10.9	3.1	3.1	6.3	1.6	25.0	7.8	0.0	1.6	26.6	7.8
TRANSPORTATION	11	0.0	0.0	0.0	9.1	9.1	0.0	18.2	9.1	27.3	0.0	0.0	0.0	9.1	18.2
UTILITIES	12	0.0	0.0	0.0	8.3	0.0	0.0	8.3	8.3	33.3	16.7	0.0	8.3	16.7	0.0
RETAIL	10	0.0	10.0	0.0	10.0	10.0	0.0	20.0	0.0	40.0	0.0	0.0	0.0	10.0	0.0
FINANCE	17	5.9	0.0	0.0	5.9	11.8	11.8	5.9	11.8	11.8	5.9	0.0	5.9	17.6	5.9
PROFESSIONAL	10	10.0	0.0	0.0	10.0	0.0	0.0	0.0	10.0	40.0	10.0	0.0	0.0	20.0	0.0
OTHER	10	0.0	0.0	0.0	0.0	10.0	0.0	0.0	10.0	40.0	0.0	0.0	0.0	30.0	10.0
SUBTOTAL	134	2.2	2.2	0.7	9.0	5.2	3.0	7.5	5.2	27.6	6.7	0.0	2.2	21.6	6.7
GOVERNMENT															
FEDERAL	24	4.2	0.0	0.0	4.2	8.3	0.0	0.0	4.2	16.7	8.3	0.0	8.3	37.5	8.3
STATE	25	4.0	0.0	8.0	4.0	0.0	12.0	8.0	4.0	16.0	8.0	0.0	0.0	36.0	0.0
LOCAL	19	0.0	0.0	5.3	0.0	5.3	10.5	5.3	0.0	15.8	0.0	0.0	0.0	47.4	10.5
SUBTOTAL	68	2.9	0.0	4.4	2.9	4.4	7.4	4.4	2.9	16.2	5.9	0.0	2.9	39.7	5.9
INSTITUTIONS															
EDUCATIONAL	22	0.0	4.5	0.0	9.1	0.0	4.5	9.1	4.5	22.7	4.5	0.0	4.5	36.4	0.0
MEDICAL	10	0.0	0.0	0.0	10.0	0.0	10.0	0.0	0.0	20.0	20.0	0.0	10.0	20.0	10.0
RELIGIOUS	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	25.0	25.0
SUBTOTAL	36	0.0	2.8	0.0	8.3	0.0	5.6	5.6	2.8	25.0	8.3	0.0	5.6	30.6	5.6
TOTAL	238	2.1	1.7	1.7	7.1	4.2	4.6	6.3	4.2	23.9	6.7	0.0	2.9	28.2	6.3

ANNUAL COMMUNICATIONS BUDGET
VOICE BUDGET IN DOLLARS (000'S)
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 67

CLASS/SUBCLASS	FREQ	LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	48	130	113000	17943
TRANSPORTATION	15	35	74000	19028
UTILITIES	8	525	8000	3009
RETAIL	9	10	20000	5454
FINANCE	12	175	90000	22918
PROFESSIONAL	10	10	48600	7077
OTHER	15	5	300000	39621
SUBTOTAL	117	5	300000	18461
GOVERNMENT				
FEDERAL	17	200	80000	12757
STATE	18	1500	120000	24567
LOCAL	15	60	30000	3458
SUBTOTAL	50	60	120000	14219
INSTITUTIONS				
EDUCATIONAL	16	250	6500	2347
MEDICAL	6	18	1500	687
RELIGIOUS	5	6	5000	1144
SUBTOTAL	27	6	6500	1755
TOTAL	194	5	300000	15043

TABLE D-62

PERCENT INCREASE IN ANNUAL COMMUNICATIONS BUDGET
VOICE BUDGET
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 63

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	58	¯10	50	13
TRANSPORTATION	16	0	30	11
UTILITIES	10	3	20	11
RETAIL	12	0	60	14
FI ANCE	15	¯20	100	15
PROFESSIONAL	13	0	45	15
OTHER	16	0	30	11
SUBTOTAL	140	¯20	100	13
GOVERNMENT				
FEDERAL	17	¯20	15	1
STATE	17	0	25	14
LOCAL	17	0	25	9
SUBTOTAL	51	¯20	25	8
INSTITUTIONS				
EDUCATIONAL	17	0	25	11
MEDICAL	6	0	13	9
RELIGIOUS	6	10	25	15
SUBTOTAL	29	0	25	11
TOTAL	220	¯20	100	11

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TABLE D-63

PERCENT OF INCREASE IN ANNUAL VOLUME OF SERVICES
VOICE SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 69

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	57	¯10	100	11
TRANSPORTATION	16	0	30	8
UTILITIES	9	0	20	9
RETAIL	12	0	20	8
FINANCE	14	0	35	12
PROFESSIONAL	13	0	55	17
OTHER	14	0	30	9
SUBTOTAL	135	¯10	100	11
GOVERNMENT				
FEDERAL	18	¯10	15	3
STATE	18	0	20	7
LOCAL	17	0	20	5
SUBTOTAL	53	¯10	20	5
INSTITUTIONS				
EDUCATIONAL	17	0	20	9
MEDICAL	6	0	10	6
RELIGIOUS	6	0	25	10
SUBTOTAL	29	0	25	9
TOTAL	217	¯10	100	9

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TABLE D-64

VOICE SERVICES
PRIVATE LINE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 70

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	62	88.7	11.3
TRANSPORTATION	17	94.1	5.9
UTILITIES	13	92.3	7.7
RETAIL	12	83.3	16.7
FINANCE	15	100.0	0.0
PROFESSIONAL	13	76.9	23.1
OTHER	17	88.2	11.8
SUBTOTAL	149	89.3	10.7
GOVERNMENT			
FEDERAL	24	66.7	33.3
STATE	20	85.0	15.0
LOCAL	16	43.8	56.3
SUBTOTAL	60	66.7	33.3
INSTITUTIONS			
EDUCATIONAL	19	63.2	36.8
MEDICAL	9	55.6	44.4
RELIGIOUS	7	57.1	42.9
SUBTOTAL	35	60.0	40.0
TOTAL	244	79.5	20.5

TABLE D-65

VOICE SERVICES
WATS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 71

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	63	96.8	3.2
TRANSPORTATION	17	94.1	5.9
UTILITIES	13	84.6	15.4
RETAIL	12	91.7	8.3
FINANCE	15	100.0	0.0
PROFESSIONAL	13	100.0	0.0
OTHER	18	72.2	27.8
SUBTOTAL	151	92.7	7.3
GOVERNMENT			
FEDERAL	24	66.7	33.3
STATE	20	100.0	0.0
LOCAL	16	43.8	56.3
SUBTOTAL	60	71.7	28.3
INSTITUTIONS			
EDUCATIONAL	20	80.0	20.0
MEDICAL	9	33.3	66.7
RELIGIOUS	7	57.1	42.9
SUBTOTAL	36	63.9	36.1
TOTAL	247	83.4	16.6

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TABLE D-66

VOICE SERVICES
DIAL 800
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 72

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	63	92.1	7.9
TRANSPORTATION	15	93.3	6.7
UTILITIES	13	46.2	53.8
RETAIL	12	75.0	25.0
FINANCE	15	93.3	6.7
PROFESSIONAL	13	76.9	23.1
OTHER	18	55.6	44.4
SUBTOTAL	149	81.2	18.8
GOVERNMENT			
FEDERAL	24	41.7	58.3
STATE	20	85.0	15.0
LOCAL	16	6.3	93.8
SUBTOTAL	60	46.7	53.3
INSTITUTIONS			
EDUCATIONAL	20	65.0	35.0
MEDICAL	9	22.2	77.8
RELIGIOUS	7	28.6	71.4
SUBTOTAL	36	47.2	52.8
TOTAL	245	67.8	32.2

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TABLE D-67

VOICE SERVICES
TELECONFERENCING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 73

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	62	66.1	33.9
TRANSPORTATION	17	64.7	35.3
UTILITIES	13	53.8	46.2
RETAIL	11	45.5	54.5
FINANCE	15	46.7	53.3
PROFESSIONAL	13	30.8	69.2
OTHER	16	43.8	56.3
SUBTOTAL	147	55.8	44.2
GOVERNMENT			
FEDERAL	24	83.3	16.7
STATE	19	68.4	31.6
LOCAL	14	57.1	42.9
SUBTOTAL	57	71.9	28.1
INSTITUTIONS			
EDUCATIONAL	18	50.0	50.0
MEDICAL	8	50.0	50.0
RELIGIOUS	6	83.3	16.7
SUBTOTAL	32	56.3	43.8
TOTAL	236	59.7	40.3

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TABLE D-68

VOICE SERVICES
PROGRAM CHANNEL TRANSMISSION
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 74

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	61	39.3	60.7
TRANSPORTATION	16	43.8	56.3
UTILITIES	13	23.1	76.9
RETAIL	11	54.5	45.5
FINANCE	15	26.7	73.3
PROFESSIONAL	13	30.8	69.2
OTHER	16	25.0	75.0
SUBTOTAL	145	35.9	64.1
GOVERNMENT			
FEDERAL	22	18.2	81.8
STATE	20	25.0	75.0
LOCAL	13	15.4	84.6
SUBTOTAL	55	20.0	80.0
INSTITUTIONS			
EDUCATIONAL	18	16.7	83.3
MEDICAL	8	25.0	75.0
RELIGIOUS	5	20.0	80.0
SUBTOTAL	31	19.4	80.6
TOTAL	231	29.9	70.1

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TABLE D-69

VOICE SERVICES
MOBILE RADIO
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 75

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	61	52.5	47.5
TRANSPORTATION	17	58.8	41.2
UTILITIES	13	61.5	38.5
RETAIL	10	20.0	80.0
FINANCE	15	20.0	80.0
PROFESSIONAL	13	38.5	61.5
OTHER	17	29.4	70.6
SUBTOTAL	146	44.5	55.5
GOVERNMENT			
FEDERAL	22	40.9	59.1
STATE	20	75.0	25.0
LOCAL	16	75.0	25.0
SUBTOTAL	58	62.1	37.9
INSTITUTIONS			
EDUCATIONAL	20	40.0	60.0
MEDICAL	9	22.2	77.8
RELIGIOUS	7	14.3	85.7
SUBTOTAL	36	30.6	69.4
TOTAL	240	46.7	53.3

TABLE D-70

INTRA-ORGANIZATIONAL COMMUNICATIONS NEEDS
VOICE SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 76

CLASS/SUBCLASS	FREQ	LOW	PERCENT HIGH	MEAN
BUSINESS				
MANUFACTURING	60	20	95	57
TRANSPORTATION	16	0	80	36
UTILITIES	10	65	95	77
RETAIL	11	20	90	58
FINANCE	15	15	90	55
PROFESSIONAL	12	10	80	43
OTHER	16	10	80	49
SUBTOTAL	140	0	95	54
GOVERNMENT				
FEDERAL	23	20	100	58
STATE	16	33	95	66
LOCAL	17	10	95	65
SUBTOTAL	56	10	100	63
INSTITUTIONS				
EDUCATIONAL	17	20	75	54
MEDICAL	8	10	85	65
RELIGIOUS	7	35	95	68
SUBTOTAL	32	10	95	60
TOTAL	228	0	100	57

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TABLE D-71

INTER-ORGANIZATIONAL COMMUNICATIONS NEEDS
VOICE SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 77

CLASS/SUBCLASS	FREQ	LOW	PERCENT HIGH	MEAN
BUSINESS				
MANUFACTURING	60	5	80	43
TRANSPORTATION	16	20	100	64
UTILITIES	10	5	35	23
RETAIL	11	10	80	42
FINANCE	15	10	85	45
PROFESSIONAL	12	20	90	57
OTHER	16	20	90	51
SUBTOTAL	140	5	100	46
GOVERNMENT				
FEDERAL	23	0	80	42
STATE	16	5	67	34
LOCAL	17	10	90	35
SUBTOTAL	56	0	90	37
INSTITUTIONS				
EDUCATIONAL	17	25	80	46
MEDICAL	8	15	90	35
RELIGIOUS	7	5	65	32
SUBTOTAL	32	5	90	40
TOTAL	228	0	100	43

TABLE D-72

PEAK HOUR
VOICE COMMUNICATIONS - FIRST PEAK
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 78

CLASS/SUBCLASS	FREQ	NO PEAK PCT	9 AM PCT	10 AM PCT	11 AM PCT	12 PM PCT	1 PM PCT	2 PM PCT	3 PM PCT	4 PM PCT	OTHER PCT
					TIME OF DAY						
BUSINESS											
MANUFACTURING	55	1.8	10.9	61.8	12.7	0.0	5.5	5.5	0.0	1.8	0.0
TRANSPORTATION	15	6.7	20.0	46.7	13.3	0.0	0.0	6.7	0.0	0.0	6.7
UTILITIES	13	7.7	7.7	38.5	15.4	0.0	0.0	0.0	0.0	7.7	23.1
RETAIL	11	0.0	0.0	90.9	9.1	0.0	0.0	0.0	0.0	0.0	0.0
FINANCE	15	6.7	20.0	40.0	20.0	6.7	0.0	6.7	0.0	0.0	0.0
PROFESSIONAL	10	0.0	40.0	0.0	20.0	0.0	0.0	30.0	0.0	0.0	10.0
OTHER	16	6.3	12.5	43.8	18.8	0.0	0.0	0.0	0.0	0.0	18.8
SUBTOTAL	135	3.7	14.1	51.1	14.8	0.7	2.2	5.9	0.0	1.5	5.9
GOVERNMENT											
FEDERAL	23	21.7	4.3	34.8	26.1	0.0	0.0	8.7	4.3	0.0	0.0
STATE	19	0.0	0.0	57.9	31.6	0.0	0.0	10.5	0.0	0.0	0.0
LOCAL	16	18.8	18.8	25.0	25.0	0.0	0.0	0.0	6.3	6.3	0.0
SUBTOTAL	58	13.8	6.9	39.7	27.6	0.0	0.0	6.9	3.4	1.7	0.0
INSTITUTIONS											
EDUCATIONAL	18	5.6	5.6	61.1	22.2	0.0	0.0	0.0	0.0	0.0	5.6
MEDICAL	9	11.1	22.2	44.4	22.2	0.0	0.0	0.0	0.0	0.0	0.0
RELIGIOUS	7	28.6	0.0	28.6	14.3	0.0	0.0	14.3	0.0	0.0	14.3
SUBTOTAL	34	11.8	8.8	50.0	20.6	0.0	0.0	2.9	0.0	0.0	5.9
TOTAL	227	7.5	11.5	48.0	18.9	0.4	1.3	5.7	0.9	1.3	4.4

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TABLE D-73

PEAK HOUR
VOICE COMMUNICATIONS - SECOND PEAK
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 79

CLASS/SUBCLASS	FREQ	NO PEAK PCT	9 AM PCT	10 AM PCT	11 AM PCT	12 PM PCT	1 PM PCT	2 PM PCT	3 PM PCT	4 PM PCT	OTHR PCT
BUSINESS											
MANUFACTURING	47	2.1	0.0	2.1	2.1	0.0	6.4	68.1	19.1	0.0	0.0
TRANSPORTATION	12	8.3	8.3	0.0	0.0	0.0	0.0	50.0	25.0	8.3	0.0
UTILITIES	9	11.1	0.0	0.0	11.1	0.0	0.0	55.6	22.2	0.0	0.0
RETAIL	10	0.0	0.0	0.0	0.0	0.0	0.0	80.0	20.0	0.0	0.0
FINANCE	13	7.7	0.0	7.7	0.0	0.0	15.4	30.8	38.5	0.0	0.0
PROFESSIONAL	6	0.0	0.0	0.0	0.0	0.0	16.7	50.0	16.7	16.7	0.0
OTHER	14	7.1	7.1	0.0	0.0	0.0	0.0	50.0	28.6	0.0	7.1
SUBTOTAL	111	4.5	1.8	1.8	1.8	0.0	5.4	58.6	23.4	1.8	0.9
GOVERNMENT											
FEDERAL	18	22.2	0.0	0.0	0.0	0.0	5.6	38.9	27.8	5.6	0.0
STATE	12	0.0	0.0	0.0	0.0	0.0	8.3	50.0	41.7	0.0	0.0
LOCAL	14	21.4	7.1	0.0	0.0	0.0	0.0	14.3	35.7	21.4	0.0
SUBTOTAL	44	15.9	2.3	0.0	0.0	0.0	4.5	34.1	34.1	9.1	0.0
INSTITUTIONS											
EDUCATIONAL	17	5.9	0.0	0.0	0.0	0.0	0.0	52.9	41.2	0.0	0.0
MEDICAL	8	0.0	0.0	0.0	0.0	0.0	0.0	50.0	37.5	12.5	0.0
RELIGIOUS	7	28.6	0.0	0.0	0.0	0.0	0.0	28.6	28.6	0.0	14.3
SUBTOTAL	32	9.4	0.0	0.0	0.0	0.0	0.0	46.9	37.5	3.1	3.1
TOTAL	187	8.0	1.6	1.1	1.1	0.0	4.3	50.8	28.3	3.7	1.1

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TABLE D-74

ANNUAL COMMUNICATIONS BUDGET
DATA BUDGET IN DOLLARS (000'S)
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 80

CLASS/SUBCLASS	FREQ	LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	43	30	37000	5108
TRANSPORTATION	14	330	20000	6606
UTILITIES	8	100	6450	1903
RETAIL	9	5	5000	1469
FINANCE	12	125	80000	13274
PROFESSIONAL	8	60	32000	8564
OTHER	14	0	200000	22288
SUBTOTAL	108	0	200000	8152
GOVERNMENT				
FEDERAL	18	10	40000	6108
STATE	17	300	30000	5712
LOCAL	13	0	13500	1473
SUBTOTAL	48	0	40000	4712
INSTITUTIONS				
EDUCATIONAL	14	40	7000	1385
MEDICAL	6	2	1000	321
RELIGIOUS	3	100	3400	1220
SUBTOTAL	23	2	7000	1086
TOTAL	179	0	200000	6322

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TABLE D-75

PERCENT INCREASE IN ANNUAL COMMUNICATIONS BUDGET
DATA BUDGET
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 81

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	53	¯10	80	13
TRANSPORTATION	15	0	30	11
UTILITIES	10	9	30	18
RETAIL	10	0	60	16
FINANCE	15	0	100	18
PROFESSIONAL	10	0	55	15
OTHER	13	0	30	11
SUBTOTAL	126	¯10	100	14
GOVERNMENT				
FEDERAL	18	¯5	20	6
STATE	18	0	20	15
LOCAL	11	0	400	42
SUBTOTAL	47	¯5	400	18
INSTITUTIONS				
EDUCATIONAL	14	0	25	10
MEDICAL	6	10	20	12
RELIGIOUS	4	5	15	11
SUBTOTAL	24	0	25	11
TOTAL	197	¯10	400	15

TABLE D-76

PERCENT OF INCREASE IN ANNUAL VOLUME OF SERVICES
DATA SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 82

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	54	−10	80	12
TRANSPORTATION	14	0	30	10
UTILITIES	8	9	40	22
RETAIL	10	0	20	12
FINANCE	15	0	50	17
PROFESSIONAL	11	4	75	18
OTHER	12	0	30	9
SUBTOTAL	124	−10	80	13
GOVERNMENT				
FEDERAL	17	−5	30	7
STATE	18	0	20	12
LOCAL	11	0	600	62
SUBTOTAL	46	−5	600	22
INSTITUTIONS				
EDUCATIONAL	14	0	30	10
MEDICAL	6	5	20	10
RELIGIOUS	4	3	15	7
SUBTOTAL	24	0	30	10
TOTAL	194	−10	600	15

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TABLE D-77

DATA SERVICES
ORGANIZATION OF DATA PROCESSING OPERATIONS
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 83

CLASS/SUBCLASS	FREQ	HOW ORGANIZED CENTRALIZED PCT	DECENTRALIZED PCT
BUSINESS			
MANUFACTURING	48	62.5	37.5
TRANSPORTATION	13	92.3	7.7
UTILITIES	12	91.7	8.3
RETAIL	7	71.4	28.6
FINANCE	12	75.0	25.0
PROFESSIONAL	11	81.8	18.2
OTHER	12	83.3	16.7
SUBTOTAL	115	74.8	25.2
GOVERNMENT			
FEDERAL	21	71.4	28.6
STATE	20	50.0	50.0
LOCAL	12	83.3	16.7
SUBTOTAL	53	66.0	34.0
INSTITUTIONS			
EDUCATIONAL	15	93.3	6.7
MEDICAL	9	88.9	11.1
RELIGIOUS	5	100.0	0.0
SUBTOTAL	29	93.1	6.9
TOTAL	197	75.1	24.9

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TABLE D-78

DATA SERVICES
DATA TRANSFER
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 84

		USE	
	FREQ	YES PCT	NO PCT
BUSINESS			
MANUFACTURING	58	94.8	5.2
TRANSPORTATION	14	92.9	7.1
UTILITIES	13	92.3	7.7
RETAIL	10	80.0	20.0
FINANCE	13	100.0	0.0
PROFESSIONAL	10	100.0	0.0
OTHER	16	87.5	12.5
SUBTOTAL	134	93.3	6.7
GOVERNMENT			
FEDERAL	22	81.8	18.2
STATE	18	94.4	5.6
LOCAL	15	86.7	13.3
SUBTOTAL	55	87.3	12.7
INSTITUTIONS			
EDUCATIONAL	19	89.5	10.5
MEDICAL	9	77.8	22.2
RELIGIOUS	5	100.0	0.0
SUBTOTAL	33	87.9	12.1
TOTAL	222	91.0	9.0

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TABLE D-79

DATA SERVICES
BATCH PROCESSING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 85

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	60	81.7	18.3
TRANSPORTATION	16	75.0	25.0
UTILITIES	13	100.0	0.0
RETAIL	11	81.8	18.2
FINANCE	15	86.7	13.3
PROFESSIONAL	10	100.0	0.0
OTHER	16	62.5	37.5
SUBTOTAL	141	82.3	17.7
GOVERNMENT			
FEDERAL	23	78.3	21.7
STATE	18	94.4	5.6
LOCAL	15	66.7	33.3
SUBTOTAL	56	80.4	19.6
INSTITUTIONS			
EDUCATIONAL	19	89.5	10.5
MEDICAL	9	88.9	11.1
RELIGIOUS	5	100.0	0.0
SUBTOTAL	33	90.9	9.1
TOTAL	230	83.0	17.0

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TABLE D-80

DATA SERVICES
DATA ENTRY
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 86

	FREQ	USE YES PCT	NO PCT
BUSINESS			
MANUFACTURING	59	94.9	5.1
TRANSPORTATION	16	100.0	0.0
UTILITIES	12	100.0	0.0
RETAIL	10	90.0	10.0
FINANCE	14	100.0	0.0
PROFESSIONAL	10	100.0	0.0
OTHER	14	78.6	21.4
SUBTOTAL	135	94.8	5.2
GOVERNMENT			
FEDERAL	23	87.0	13.0
STATE	18	100.0	0.0
LOCAL	15	80.0	20.0
SUBTOTAL	56	89.3	10.7
INSTITUTIONS			
EDUCATIONAL	19	89.5	10.5
MEDICAL	9	100.0	0.0
RELIGIOUS	4	100.0	0.0
SUBTOTAL	32	93.8	6.3
TOTAL	223	93.3	6.7

TABLE D-81

DATA SERVICES
REMOTE JOB ENTRY
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 87

	FREQ	USE YES PCT	NO PCT
BUSINESS			
MANUFACTURING	60	81.7	18.3
TRANSPORTATION	16	62.5	37.5
UTILITIES	13	69.2	30.8
RETAIL	11	81.8	18.2
FINANCE	14	92.9	7.1
PROFESSIONAL	10	90.0	10.0
OTHER	15	80.0	20.0
SUBTOTAL	139	79.9	20.1
GOVERNMENT			
FEDERAL	22	72.7	27.3
STATE	18	83.3	16.7
LOCAL	15	73.3	26.7
SUBTOTAL	55	76.4	23.6
INSTITUTIONS			
EDUCATIONAL	18	94.4	5.6
MEDICAL	9	77.8	22.2
RELIGIOUS	4	75.0	25.0
SUBTOTAL	31	87.1	12.9
TOTAL	225	80.0	20.0

TABLE D-82

DATA SERVICES
INQUIRE/RESPONSE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 88

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	60	90.0	10.0
TRANSPORTATION	16	93.8	6.3
UTILITIES	13	92.3	7.7
RETAIL	10	90.0	10.0
FINANCE	15	86.7	13.3
PROFESSIONAL	10	70.0	30.0
OTHER	15	80.0	20.0
SUBTOTAL	139	87.8	12.2
GOVERNMENT			
FEDERAL	22	68.2	31.8
STATE	18	88.9	11.1
LOCAL	13	69.2	30.8
SUBTOTAL	53	75.5	24.5
INSTITUTIONS			
EDUCATIONAL	19	100.0	0.0
MEDICAL	9	88.9	11.1
RELIGIOUS	4	50.0	50.0
SUBTOTAL	32	90.6	9.4
TOTAL	224	85.3	14.7

TABLE D-83

DATA SERVICES
TIME SHARING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 89

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	61	67.2	32.8
TRANSPORTATION	16	81.3	18.8
UTILITIES	13	92.3	7.7
RETAIL	11	45.5	54.5
FINANCE	15	60.0	40.0
PROFESSIONAL	11	81.8	18.2
OTHER	17	70.6	29.4
SUBTOTAL	144	70.1	29.9
GOVERNMENT			
FEDERAL	23	69.6	30.4
STATE	18	83.3	16.7
LOCAL	15	33.3	66.7
SUBTOTAL	56	64.3	35.7
INSTITUTIONS			
EDUCATIONAL	19	78.9	21.1
MEDICAL	8	75.0	25.0
RELIGIOUS	5	60.0	40.0
SUBTOTAL	32	75.0	25.0
TOTAL	232	69.4	30.6

TABLE D-84

DATA SERVICES
ADMINISTRATIVE MESSAGES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 90

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	60	61.7	38.3
TRANSPORTATION	16	75.0	25.0
UTILITIES	13	15.4	84.6
RETAIL	11	18.2	81.8
FINANCE	14	57.1	42.9
PROFESSIONAL	11	54.5	45.5
OTHER	17	35.3	64.7
SUBTOTAL	142	51.4	48.6
GOVERNMENT			
FEDERAL	23	52.2	47.8
STATE	20	25.0	75.0
LOCAL	15	0.0	100.0
SUBTOTAL	58	29.3	70.7
INSTITUTIONS			
EDUCATIONAL	18	44.4	55.6
MEDICAL	7	28.6	71.4
RELIGIOUS	5	0.0	100.0
SUBTOTAL	30	33.3	66.7
TOTAL	230	43.5	56.5

TABLE D-85

DATA SERVICES
WORD PROCESSING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 91

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	61	75.4	24.6
TRANSPORTATION	16	75.0	25.0
UTILITIES	13	30.8	69.2
RETAIL	11	54.5	45.5
FINANCE	15	60.0	40.0
PROFESSIONAL	11	63.6	36.4
OTHER	16	50.0	50.0
SUBTOTAL	143	64.3	35.7
GOVERNMENT			
FEDERAL	23	73.9	26.1
STATE	19	63.2	36.8
LOCAL	15	33.3	66.7
SUBTOTAL	57	59.6	40.4
INSTITUTIONS			
EDUCATIONAL	18	66.7	33.3
MEDICAL	8	75.0	25.0
RELIGIOUS	5	60.0	40.0
SUBTOTAL	31	67.7	32.3
TOTAL	231	63.6	36.4

TABLE D-86

DATA SERVICES
MAILBOX SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 92

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	58	25.9	74.1
TRANSPORTATION	16	25.0	75.0
UTILITIES	12	0.0	100.0
RETAIL	11	36.4	63.6
FINANCE	15	33.3	66.7
PROFESSIONAL	10	10.0	90.0
OTHER	16	31.3	68.8
SUBTOTAL	138	24.6	75.4
GOVERNMENT			
FEDERAL	23	34.8	65.2
STATE	20	10.0	90.0
LOCAL	13	0.0	100.0
SUBTOTAL	56	17.9	82.1
INSTITUTIONS			
EDUCATIONAL	18	44.4	55.6
MEDICAL	7	14.3	85.7
RELIGIOUS	5	0.0	100.0
SUBTOTAL	30	30.0	70.0
TOTAL	224	23.7	76.3

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TABLE D-87

DATA SERVICES
FACSIMILE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 93

	FREQ	USE YES PCT	NO PCT
BUSINESS			
MANUFACTURING	60	95.0	5.0
TRANSPORTATION	16	81.3	18.8
UTILITIES	13	92.3	7.7
RETAIL	10	80.0	20.0
FINANCE	14	92.9	7.1
PROFESSIONAL	12	75.0	25.0
OTHER	17	100.0	0.0
SUBTOTAL	142	90.8	9.2
GOVERNMENT			
FEDERAL	22	86.4	13.6
STATE	20	80.0	20.0
LOCAL	15	53.3	46.7
SUBTOTAL	57	75.4	24.6
INSTITUTIONS			
EDUCATIONAL	16	68.8	31.3
MEDICAL	9	55.6	44.4
RELIGIOUS	6	66.7	33.3
SUBTOTAL	31	64.5	35.5
TOTAL	230	83.5	16.5

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TABLE D-88

DATA SERVICES
TWX AND TELEX
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 94

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	60	95.0	5.0
TRANSPORTATION	16	81.3	18.8
UTILITIES	13	76.9	23.1
RETAIL	10	60.0	40.0
FINANCE	14	78.6	21.4
PROFESSIONAL	13	76.9	23.1
OTHER	17	94.1	5.9
SUBTOTAL	143	86.0	14.0
GOVERNMENT			
FEDERAL	22	86.4	13.6
STATE	20	65.0	35.0
LOCAL	15	46.7	53.3
SUBTOTAL	57	68.4	31.6
INSTITUTIONS			
EDUCATIONAL	18	72.2	27.8
MEDICAL	9	44.4	55.6
RELIGIOUS	5	60.0	40.0
SUBTOTAL	32	62.5	37.5
TOTAL	232	78.4	21.6

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TABLE D-89

DATA SERVICES
MAILGRAM
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 95

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	60	66.7	33.3
TRANSPORTATION	16	43.8	56.3
UTILITIES	12	25.0	75.0
RETAIL	10	30.0	70.0
FINANCE	12	33.3	66.7
PROFESSIONAL	12	75.0	25.0
OTHER	16	50.0	50.0
SUBTOTAL	138	53.6	46.4
GOVERNMENT			
FEDERAL	22	50.0	50.0
STATE	20	35.0	65.0
LOCAL	15	26.7	73.3
SUBTOTAL	57	38.6	61.4
INSTITUTIONS			
EDUCATIONAL	17	41.2	58.8
MEDICAL	9	44.4	55.6
RELIGIOUS	5	60.0	40.0
SUBTOTAL	31	45.2	54.8
TOTAL	226	48.7	51.3

TABLE D-90

DATA SERVICES
SECURE VOICE
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 96

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	60	13.3	86.7
TRANSPORTATION	15	6.7	93.3
UTILITIES	12	8.3	91.7
RETAIL	10	10.0	90.0
FINANCE	14	14.3	85.7
PROFESSIONAL	12	0.0	100.0
OTHER	16	6.3	93.8
SUBTOTAL	139	10.1	89.9
GOVERNMENT			
FEDERAL	21	9.5	90.5
STATE	19	15.8	84.2
LOCAL	13	7.7	92.3
SUBTOTAL	53	11.3	88.7
INSTITUTIONS			
EDUCATIONAL	17	5.9	94.1
MEDICAL	9	0.0	100.0
RELIGIOUS	5	0.0	100.0
SUBTOTAL	31	3.2	96.8
TOTAL	223	9.4	90.6

TABLE D-91

DATA SERVICES
MONITORING SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 97

	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	58	46.6	53.4
TRANSPORTATION	16	43.8	56.3
UTILITIES	12	25.0	75.0
RETAIL	10	40.0	60.0
FINANCE	14	50.0	50.0
PROFESSIONAL	12	41.7	58.3
OTHER	16	25.0	75.0
SUBTOTAL	138	41.3	58.7
GOVERNMENT			
FEDERAL	21	28.6	71.4
STATE	19	52.6	47.4
LOCAL	13	23.1	76.9
SUBTOTAL	53	35.8	64.2
INSTITUTIONS			
EDUCATIONAL	16	56.3	43.8
MEDICAL	8	12.5	87.5
RELIGIOUS	5	20.0	80.0
SUBTOTAL	29	37.9	62.1
TOTAL	220	39.5	60.5

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TABLE D-92

INTRA-ORGANIZATIONAL COMMUNICATIONS NEEDS
DATA SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 98

CLASS/SUBCLASS	FREQ	PERCENT LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	57	5	100	78
TRANSPORTATION	15	15	100	81
UTILITIES	10	80	100	91
RETAIL	10	70	100	86
FINANCE	14	20	100	75
PROFESSIONAL	11	0	90	55
OTHER	15	10	100	81
SUBTOTAL	132	0	100	78
GOVERNMENT				
FEDERAL	20	0	100	77
STATE	17	50	98	84
LOCAL	13	30	100	86
SUBTOTAL	50	0	100	82
INSTITUTIONS				
EDUCATIONAL	17	40	99	84
MEDICAL	9	75	99	89
RELIGIOUS	5	90	100	98
SUBTOTAL	31	40	100	88
TOTAL	213	0	100	80

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TABLE D-93

INTER-ORGANIZATIONAL COMMUNICATIONS NEEDS
DATA SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 99

CLASS/SUBCLASS	FREQ	PERCENT LOW	PERCENT HIGH	MEAN
BUSINESS				
MANUFACTURING	56	0	95	22
TRANSPORTATION	15	0	85	19
UTILITIES	9	0	20	10
RETAIL	10	0	30	14
FINANCE	14	0	80	25
PROFESSIONAL	11	10	100	45
OTHER	15	0	90	19
SUBTOTAL	130	0	100	22
GOVERNMENT				
FEDERAL	17	0	100	22
STATE	16	2	50	16
LOCAL	13	0	70	14
SUBTOTAL	46	0	100	18
INSTITUTIONS				
EDUCATIONAL	17	1	60	16
MEDICAL	9	1	25	11
RELIGIOUS	4	0	10	3
SUBTOTAL	30	0	60	13
TOTAL	206	0	100	20

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TABLE D-94

PEAK HOUR
DATA COMMUNICATIONS - FIRST PEAK
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 100

CLASS/SUBCLASS	FREQ	NO PEAK PCT	9 AM PCT	10 AM PCT	11 AM PCT	12 PM PCT	1 PM PCT	2 PM PCT	3 PM PCT	4 PM PCT	OTHR PCT
						TIME OF DAY					
BUSINESS											
MANUFACTURING	48	25.0	10.4	33.3	4.2	0.0	4.2	12.5	4.2	4.2	2.1
TRANSPORTATION	15	40.0	13.3	26.7	0.0	0.0	0.0	0.0	6.7	0.0	13.3
UTILITIES	11	36.4	9.1	9.1	18.2	0.0	0.0	9.1	0.0	9.1	9.1
RETAIL	7	28.6	0.0	57.1	0.0	0.0	0.0	0.0	0.0	0.0	14.3
FINANCE	12	33.3	8.3	16.7	16.7	8.3	0.0	8.3	0.0	0.0	8.3
PROFESSIONAL	10	10.0	10.0	20.0	10.0	0.0	0.0	20.0	0.0	0.0	30.0
OTHER	11	45.5	0.0	27.3	0.0	0.0	0.0	9.1	9.1	0.0	9.1
SUBTOTAL	114	29.8	8.8	28.1	6.1	0.9	1.8	9.6	3.5	2.6	8.8
GOVERNMENT											
FEDERAL	16	37.5	6.3	31.3	0.0	0.0	0.0	12.5	6.3	6.3	0.0
STATE	13	46.2	7.7	7.7	7.7	7.7	0.0	23.1	0.0	0.0	0.0
LOCAL	11	54.5	18.2	18.2	0.0	0.0	0.0	0.0	0.0	0.0	9.1
SUBTOTAL	40	45.0	10.0	20.0	2.5	2.5	0.0	12.5	2.5	2.5	2.5
INSTITUTIONS											
EDUCATIONAL	15	33.3	0.0	53.3	6.7	0.0	0.0	0.0	0.0	0.0	6.7
MEDICAL	6	66.7	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	16.7
RELIGIOUS	5	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	26	53.8	0.0	34.6	3.8	0.0	0.0	0.0	0.0	0.0	7.7
TOTAL	180	36.7	7.8	27.2	5.0	1.1	1.1	8.9	2.8	2.2	7.2

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TABLE D-95

PEAK HOUR
DATA COMMUNICATIONS - SECOND PEAK
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 101

CLASS/SUBCLASS	FREQ	NO PEAK PCT	9 AM PCT	10 AM PCT	11 AM PCT	12 PM PCT	1 PM PCT	2 PM PCT	3 PM PCT	4 PM PCT	OTHR PCT
					TIME OF DAY						
BUSINESS											
MANUFACTURING	35	34.3	0.0	0.0	2.9	0.0	2.9	31.4	8.6	11.4	8.6
TRANSPORTATION	12	50.0	0.0	8.3	0.0	0.0	0.0	16.7	8.3	8.3	8.3
UTILITIES	6	66.7	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	16.7
RETAIL	4	50.0	25.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0
FINANCE	10	40.0	0.0	0.0	0.0	0.0	0.0	10.0	30.0	20.0	0.0
PROFESSIONAL	4	25.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0	0.0	0.0
OTHER	8	62.5	0.0	0.0	0.0	0.0	0.0	25.0	12.5	0.0	0.0
SUBTOTAL	79	43.0	1.3	1.3	1.3	0.0	1.3	25.3	11.4	8.9	6.3
GOVERNMENT											
FEDERAL	13	38.5	0.0	0.0	0.0	0.0	0.0	7.7	38.5	7.7	7.7
STATE	9	66.7	0.0	0.0	0.0	0.0	0.0	0.0	11.1	11.1	11.1
LOCAL	11	54.5	0.0	0.0	0.0	0.0	9.1	18.2	9.1	0.0	9.1
SUBTOTAL	33	51.5	0.0	0.0	0.0	0.0	3.0	9.1	21.2	6.1	9.1
INSTITUTIONS											
EDUCATIONAL	13	30.8	0.0	0.0	0.0	0.0	0.0	30.8	23.1	7.7	7.7
MEDICAL	6	66.7	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	16.7
RELIGIOUS	5	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	24	54.2	0.0	0.0	0.0	0.0	0.0	16.7	16.7	4.2	8.3
TOTAL	136	47.1	0.7	0.7	0.7	0.0	1.5	19.9	14.7	7.4	7.4

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TABLE D-96

VIDEO SERVICES
USE OF VIDEO TELECONFERENCING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 102

CLASS/SUBCLASS	FREQ	USE YES PCT	USE NO PCT
BUSINESS			
MANUFACTURING	61	24.6	75.4
TRANSPORTATION	15	6.7	93.3
UTILITIES	13	0.0	100.0
RETAIL	11	9.1	90.9
FINANCE	15	20.0	80.0
PROFESSIONAL	12	16.7	83.3
OTHER	18	16.7	83.3
SUBTOTAL	145	17.2	82.8
GOVERNMENT			
FEDERAL	19	5.3	94.7
STATE	20	10.0	90.0
LOCAL	16	0.0	100.0
SUBTOTAL	55	5.5	94.5
INSTITUTIONS			
EDUCATIONAL	19	10.5	89.5
MEDICAL	8	25.0	75.0
RELIGIOUS	7	28.6	71.4
SUBTOTAL	34	17.6	82.4
TOTAL	234	14.5	85.5

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TABLE D-97

ANNUAL COMMUNICATIONS BUDGET
VIDEO BUDGET IN DOLLARS (000'S)
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 103

CLASS/SUBCLASS	FREQ	LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	11	20	3000	734
TRANSPORTATION	0	0	0	0
UTILITIES	0	0	0	0
RETAIL	1	0	0	0
FINANCE	3	100	200	133
PROFESSIONAL	2	200	600	400
OTHER	2	12	250	131
SUBTOTAL	19	0	3000	502
GOVERNMENT				
FEDERAL	0	0	0	0
STATE	1	100	100	100
LOCAL	0	0	0	0
SUBTOTAL	1	0	100	100
INSTITUTIONS				
EDUCATIONAL	0	0	0	0
MEDICAL	1	860	860	860
RELIGIOUS	0	0	0	0
SUBTOTAL	1	0	860	860
TOTAL	21	0	3000	500

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TABLE D-98

PERCENT INCREASE IN ANNUAL COMMUNICATIONS BUDGET
VIDEO BUDGET
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 104

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	14	0	300	39
TRANSPORTATION	0	0	0	0
UTILITIES	0	0	0	0
RETAIL	0	0	0	0
FINANCE	2	0	20	10
PROFESSIONAL	1	13	13	13
OTHER	2	5	10	8
SUBTOTAL	19	0	300	31
GOVERNMENT				
FEDERAL	0	0	0	0
STATE	1	0	0	0
LOCAL	1	100	100	100
SUBTOTAL	2	0	100	50
INSTITUTIONS				
EDUCATIONAL	0	0	0	0
MEDICAL	1	22	22	22
RELIGIOUS	1	10	10	10
SUBTOTAL	2	0	22	16
TOTAL	23	0	300	32

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TABLE D-99

PERCENT OF INCREASE IN ANNUAL VOLUME OF SERVICES
VIDEO SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 105

CLASS/SUBCLASS	FREQ	PERCENT OF INCREASE LOW	HIGH	MEAN
BUSINESS				
MANUFACTURING	13	0	600	85
TRANSPORTATION	0	0	0	0
UTILITIES	0	0	0	0
RETAIL	0	0	0	0
FINANCE	2	0	20	10
PROFESSIONAL	1	35	35	35
OTHER	3	5	20	15
SUBTOTAL	19	0	600	63
GOVERNMENT				
FEDERAL	0	0	0	0
STATE	1	0	0	0
LOCAL	1	100	100	100
SUBTOTAL	2	0	100	50
INSTITUTIONS				
EDUCATIONAL	0	0	0	0
MEDICAL	1	0	0	0
RELIGIOUS	1	10	10	10
SUBTOTAL	2	0	10	5
TOTAL	23	0	600	57

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TABLE D-100

VIDEO SERVICES
BIT RATE FOR VIDEO TELECONFERENCING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 106

CLASS/SUBCLASS	FREQ	BIT RATE (BPS) 9.6K PCT	56K PCT	1.5M PCT	6.3M PCT
BUSINESS					
MANUFACTURING	10	10.0	0.0	60.0	30.0
TRANSPORTATION	0	0.0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0	0.0
FINANCE	3	0.0	0.0	33.3	66.7
PROFESSIONAL	1	0.0	0.0	100.0	0.0
OTHER	1	0.0	0.0	100.0	0.0
SUBTOTAL	15	6.7	0.0	60.0	33.3
GOVERNMENT					
FEDERAL	0	0.0	0.0	0.0	0.0
STATE	1	0.0	0.0	0.0	100.0
LOCAL	0	0.0	0.0	0.0	0.0
SUBTOTAL	1	0.0	0.0	0.0	100.0
INSTITUTIONS					
EDUCATIONAL	0	0.0	0.0	0.0	0.0
MEDICAL	0	0.0	0.0	0.0	0.0
RELIGIOUS	0	0.0	0.0	0.0	0.0
SUBTOTAL	0	0.0	0.0	0.0	0.0
TOTAL	16	6.3	0.0	56.3	37.5

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TABLE D-101

VIDEO SERVICES
ONE WAY OR TWO WAY VIDEO TELECONFERENCING
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 107

CLASS/SUBCLASS	FREQ	INTERACTION ONE WAY PCT	TWO-WAY PCT
BUSINESS			
MANUFACTURING	13	23.1	76.9
TRANSPORTATION	1	0.0	100.0
UTILITIES	0	0.0	0.0
RETAIL	1	0.0	100.0
FINANCE	4	25.0	75.0
PROFESSIONAL	2	0.0	100.0
OTHER	3	66.7	33.3
SUBTOTAL	24	25.0	75.0
GOVERNMENT			
FEDERAL	0	0.0	0.0
STATE	1	0.0	100.0
LOCAL	0	0.0	0.0
SUBTOTAL	1	0.0	100.0
INSTITUTIONS			
EDUCATIONAL	1	0.0	100.0
MEDICAL	1	0.0	100.0
RELIGIOUS	2	100.0	0.0
SUBTOTAL	4	50.0	50.0
TOTAL	29	27.6	72.4

TABLE D-102

VIDEO SERVICES
USE OF VIDEO TELECONFERENCING
BY CLASS AND SUBCLASS OF USERS
QUESTIONS NO. 108 109 110

CLASS/SUBCLASS	FREQ	MEETINGS PCT	USES EDUCAT. PCT	MISC. PCT
BUSINESS				
MANUFACTURING	12	58.3	8.3	33.3
TRANSPORTATION	2	50.0	50.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	1	100.0	0.0	0.0
FINANCE	3	66.7	33.3	0.0
PROFESSIONAL	3	33.3	33.3	33.3
OTHER	2	100.0	0.0	0.0
SUBTOTAL	23	60.9	17.4	21.7
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	2	100.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	2	100.0	0.0	0.0
INSTITUTIONS				
EDUCATIONAL	1	0.0	100.0	0.0
MEDICAL	1	0.0	100.0	0.0
RELIGIOUS	1	0.0	100.0	0.0
SUBTOTAL	3	0.0	100.0	0.0
TOTAL	28	57.1	25.0	17.9

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TABLE D-103

VIDEO SERVICES
WHY USE VIDEO TELECONFERENCING
BY CLASS AND SUBCLASS OF USERS
QUESTIONS NO. 111 112 113

CLASS/SUBCLASS	FREQ	SAVE TIME PCT	REASONS REDUCE TRAVEL PCT	INCREASE ACCESS PCT
BUSINESS				
MANUFACTURING	8	37.5	50.0	12.5
TRANSPORTATION	1	0.0	100.0	0.0
UTILITIES	0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0
FINANCE	5	40.0	40.0	20.0
PROFESSIONAL	4	25.0	50.0	25.0
OTHER	3	33.3	66.7	0.0
SUBTOTAL	21	33.3	52.4	14.3
GOVERNMENT				
FEDERAL	0	0.0	0.0	0.0
STATE	2	50.0	50.0	0.0
LOCAL	0	0.0	0.0	0.0
SUBTOTAL	2	50.0	50.0	0.0
INSTITUTIONS				
EDUCATIONAL	0	0.0	0.0	0.0
MEDICAL	1	0.0	0.0	100.0
RELIGIOUS	2	0.0	50.0	50.0
SUBTOTAL	3	0.0	33.3	66.7
TOTAL	26	30.8	50.0	19.2

TABLE D-104

INTRA-ORGANIZATIONAL COMMUNICATIONS NEEDS
VIDEO SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 114

CLASS/SUBCLASS	FREQ	PERCENT LOW	PERCENT HIGH	PERCENT MEAN
BUSINESS				
MANUFACTURING	12	50	100	95
TRANSPORTATION	1	100	100	100
UTILITIES	0	0	0	0
RETAIL	1	100	100	100
FINANCE	3	100	100	100
PROFESSIONAL	2	100	100	100
OTHER	3	0	100	67
SUBTOTAL	22	0	100	92
GOVERNMENT				
FEDERAL	0	0	0	0
STATE	2	20	60	40
LOCAL	0	0	0	0
SUBTOTAL	2	0	60	40
INSTITUTIONS				
EDUCATIONAL	0	0	0	0
MEDICAL	1	100	100	100
RELIGIOUS	1	100	100	100
SUBTOTAL	2	0	100	100
TOTAL	26	0	100	89

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TABLE D-105

INTER-ORGANIZATIONAL COMMUNICATIONS NEEDS
VIDEO SERVICES
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 115

CLASS/SUBCLASS	FREQ	PERCENT LOW	PERCENT HIGH	PERCENT MEAN
BUSINESS				
MANUFACTURING	12	0	50	5
TRANSPORTATION	1	0	0	0
UTILITIES	0	0	0	0
RETAIL	1	0	0	0
FINANCE	3	0	0	0
PROFESSIONAL	2	0	0	0
OTHER	3	0	100	33
SUBTOTAL	22	0	100	7
GOVERNMENT				
FEDERAL	0	0	0	0
STATE	2	40	80	60
LOCAL	0	0	[illegible]	0
SUBTOTAL	2	0	80	60
INSTITUTIONS				
EDUCATIONAL	0	0	0	0
MEDICAL	1	0	0	0
RELIGIOUS	1	0	0	0
SUBTOTAL	2	0	0	0
TOTAL	26	0	100	11

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TABLE D-106

PEAK HOUR
VIDEO COMMUNICATIONS - FIRST PEAK
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 116

CLASS/SUBCLASS	FREQ	NO PEAK PCT	9 AM PCT	10 AM PCT	11 AM PCT	12 PM PCT	1 PM PCT	2 PM PCT	3 PM PCT	4 PM PCT	OTHR PCT
						TIME OF DAY					
BUSINESS											
MANUFACTURING	9	33.3	22.2	11.1	0.0	0.0	0.0	22.2	11.1	0.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FINANCE	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
PROFESSIONAL	2	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0	50.0	0.0
OTHER	3	33.3	0.0	0.0	0.0	0.0	33.3	33.3	0.0	0.0	0.0
SUBTOTAL	15	26.7	13.3	6.7	0.0	6.7	6.7	26.7	6.7	6.7	0.0
GOVERNMENT											
FEDERAL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STATE	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
INSTITUTIONS											
EDUCATIONAL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEDICAL	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
RELIGIOUS	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	2	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0
TOTAL	18	27.8	11.1	11.1	0.0	5.6	5.6	22.2	5.6	5.6	5.6

TABLE D-107

PEAK HOUR
VIDEO COMMUNICATIONS - SECOND PEAK
BY CLASS AND SUBCLASS OF USERS
QUESTION NO. 117

		TIME OF DAY									
CLASS/SUBCLASS	FREQ	NO PEAK PCT	9 AM PCT	10 AM PCT	11 AM PCT	12 PM PCT	1 PM PCT	2 PM PCT	3 PM PCT	4 PM PCT	OTHR PCT
BUSINESS											
MANUFACTURING	4	75.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0
TRANSPORTATION	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UTILITIES	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RETAIL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FINANCE	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PROFESSIONAL	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER	2	50.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0
SUBTOTAL	8	50.0	25.0	0.0	0.0	0.0	0.0	0.0	12.5	12.5	0.0
GOVERNMENT											
FEDERAL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STATE	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
LOCAL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
INSTITUTIONS											
EDUCATIONAL	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEDICAL	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
RELIGIOUS	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUBTOTAL	2	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0
TOTAL	11	45.5	18.2	0.0	0.0	0.0	0.0	9.1	9.1	9.1	9.1

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TABLE D-108

APPENDIX E
NET LONG HAUL PEAK HOUR CPS FORECAST

E.1 INTRODUCTION

The impacted baseline was modified by the removal of the intra-SMSA traffic (i.e., traffic which flows within a Standard Metropolitan Statistical Area (SMSA)). The percent of traffic removed from each service to get to the net long haul is given in Table E-1. Three other adjustments are made to the traffic at this point: data carried by voice lines were removed, efficiency factors were applied to data traffic and annual traffic is converted to peak hour units. The resulting net long haul traffic forecast shown in Table E-5 was the basis for all traffic distribution and traffic separation analysis which follows. Figure E-1 depicts the basic flow of the analysis necessary to translate the impacted baselines into the net long haul traffic forecasts. It should be pointed out that traffic originated from, or terminated to, the hinterlands was retained; hinterland was defined as that area outside a SMSA.

E.2 INTRA SMSA TRAFFIC

A certain proportion of each service application traffic does not leave the SMSA in which it was originated. By definition this traffic does not qualify as long haul and must be removed from the forecasts. Many services already had this portion of the traffic removed, such as Network video. For other services the amount of intra-SMSA traffic varied greatly. Therefore, each service was reviewed independently and a percent of traffic was removed (see Table E-1). The percent of intra-SMSA traffic was determined through industry contacts, our literature search, the user survey and internal Western Union analysis. This step reduced the traffic by 4 percent.

E.2.1 Voice

The voice traffic forecast was analyzed using AT&T statistics as well as the physical boundaries of SMSAs. Message toll service for both residential and business in almost all inter-SMSA. The exception is in large SMSAs where some inter-SMSA traffic is counted as toll. This was found to be small. Private line

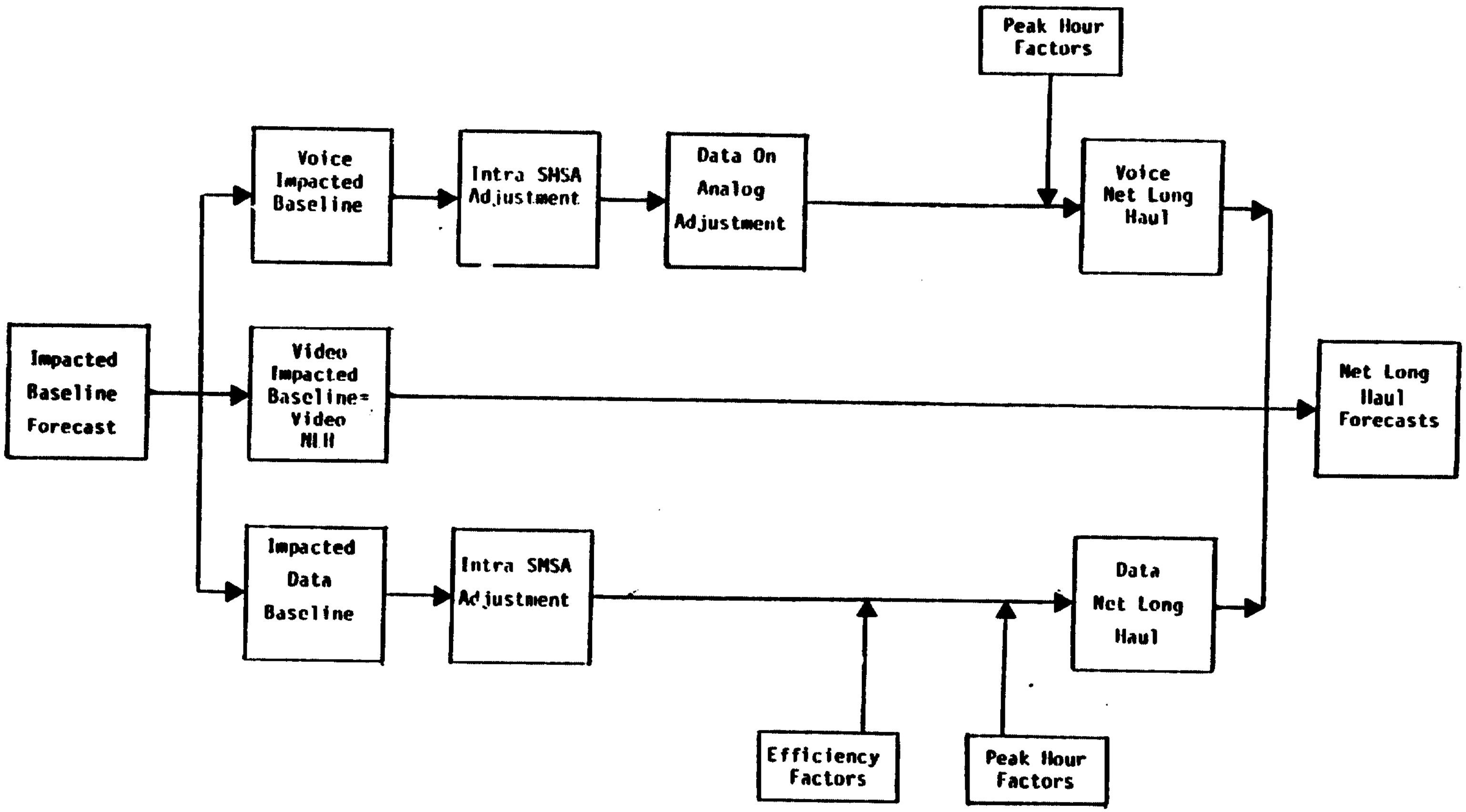

FIGURE E-1. ACTIVITY FLOW FOR NET LONG HAUL FORECASTS

and mobile telephones were treated similarly to message toll services. The various radio services are defined as inter-SMSA in the baseline and thus no traffic was removed.

E.2.2 Data

For data an internal analysis prepared by Western Union and International Data Corporation provided information about line speed and the distance traffic travels. Along with this a review of the individual services based on Western Union's own experience was used to estimate the intra SMSA traffic.

E.2.3 Video

The baseline for all video services is defined as long haul and thus an estimate of the intra SMSA traffic is meaningless.

E.3 DATA TRAFFIC CARRIED ON ANALOG (VOICE) FACILITIES

The data service category net long haul traffic forecast has been calculated on the basis of market demand - without consideration of the transmission facilities used. The voice service category has been calculated in a similar manner. However, the voice forecasts, which were based on historical growth patterns, included facilities on which data traffic was implemented. If the forecasts were not modified to acknowledge this situation, a duplication in market demand would be caused.

It was decided that the data service category forecasts should remain whole and that the voice service category should be reduced by the amount of the data traffic carried. This would allow the data market demand to remain intact as an aid to subsequent market analyses.

The methodology used to convert applicable data traffic (expressed in terabits per year) to voice traffic (expressed in half voice circuits) included the following steps:

a. Analyze each data application to determine the nature of the traffic: peak oriented; off-peak oriented; one-way; two-way or special.
b. Derive a conversion factor to convert terabits per year to half voice circuits which takes nature of traffic into account.
c. Calculate equivalent voice facilities load for all data traffic.
d. Analyze each data application to determine the proportion carried on voice facilities in 1978, 1980, 1990 and 2000.
e. Calculate net voice facilities carrying data traffic and reduce voice service category forecasts by a like amount.

Very few dedicated data facilities are currently in use. In 1980, approximately 90 percent of data traffic was carried on voice facilities. Anticipating the emergence of digital facilities, the weighted average of data on voice facilities declined to 67 percent in 1990 and 25 percent in 2000. (See Table E-2). The percent of data carried by voice lines is presented, by service and year, in Table E-1.

E.4 PEAK HOUR CONVERSION

The next step in developing the long haul peak hour traffic forecast was to establish a peaking factor for every service. Since voice is a large share of the market and its peak occurs during the business day and most services are business oriented, all peak hours were made to coincide with the 10 to 11 a.m. and the 1 to 3 p.m. business peak time frames.

E.4.1 Voice

The baseline for most voice services is defined as the peak hour traffic and therefore no conversion is necessary. The exception to this is occasional radio which is peaked at nights and weekends. A review of Western Union's WESTAR satellite traffic indicated that the traffic during the business peak hour is 75 percent of the services peak hour.

E.4.2 Data

To determine the amount of data traffic occuring in a business day, it was first necessary to divide all data services by 250 (the number of business days per year). Then each service was reviewed to see what type of daily traffic pattern was followed. The user survey and Western Union's experience provided useful insights. Most data services occur during the day and are fairly constant. Some exceptions are data transfer and batch processing which occur largely after normal hours and secure voice which follows a traffic pattern similar to voice. The number of hours during the work day the service is used and the percentage of the service taking place during those hours was used to determine the amount of traffic in the peak hour. The percent used during the work day is given in column one of Table E-3. The number of hours of constant use is given in the second column. The last column shows the factor applied to get the peak hour for each service. That is, the peak hour factor for each service was calculating multiplying the percent during the business week (.e.g. 25 for data) times 1/250 times 1/ (# hours of use 1 day figure; eg., 5 for data)

E.4.3 Video

The baseline for all video services, except Occasional Video, was defined as peak hour. The Occasional Video impacted baseline was reduced by 25 percent for each benchmark year to reflect its unique peak hour factor.

E.5 Efficiency Factor

This term refers to how efficiently data is transmitted. In the case of data the rate of transmission is often less then the channel capacity. For instance the capacity of a voice channel in 1980 was 64 Kbps, however, when a modem was introduced for data the rate of transmission was 300 or 1200 bps. In addition to this when the actual data transmitted by a typist at a keyboard is considered, this rate is reduced considerably. Other factors must also be considered such as pauses made by the typist. Most data must have a return line, thus typing up a second 64 Kbps line and error correction techniques may require retransmission.

All data efficiency factors were determined by considering that all data services were transmitted using one of two methods. First the data could be entered

manually through some type of keyboard, for example data entry, point of sale or telemonitoring. This type of transmission would be very inefficient. The second way data is normally transmitted is in a batch mode. For example, data transfer, batch processing and that portion of data entry done using a micro-computer as an input device. This type of data entry still is not totally efficient, however. For instance the return line is underutilized and error correction schemes often call for retransmission. Several other variables were also considered in determining these factors. The use of micro-computers to store and forward data in burst is a growing trend. The use of all digital transmission will mean the elimination of modems and some inefficiency. Compression techniques and the use of higher speeds will increase efficiency. These trends combined to increase the efficiency of the transmission lines in 1990 and 2000. Table E-4 presents the efficiency factors found through this analysis.

E.6 SUMMARY OF NET LONG HAUL FORECASTS

The Net Long Haul forecasts for each service for 1980, 1990, and 2000 are presented in Table E-5.

TABLE E-1
PERCENT OF TRAFFIC REMOVED FROM THE IMPACTED BASELINE
TO GIVE NET LONG HAUL TRAFFIC FORECAST

	INTRA SMSA	DATA CARRIED BY VOICE LINES		
		1980	1990	2000
MTS (Residential)	9.00	0.00	0.00	0.00
MTS (Business)	5.00	5.29	0.76	0.08
Private Line	5.00	8.69	3.61	1.01
Mobile	5.00	0.00	0.00	0.00
Public Radio	0.00	0.00	0.00	0.00
Commercial and Religious	0.00	0.00	0.00	0.00
Occasional	0.00	0.00	0.00	0.00
CATV Music	0.00	0.00	0.00	0.00
Recording	0.00	0.00	0.00	0.00
	5.83	4.95	1.55	0.40
Data Transfer	16.00	0.00	0.00	0.00
Batch Processing	20.00	0.00	0.00	0.00
Data Entry	60.00	0.00	0.00	0.00
Remote Job Entry	35.00	0.00	0.00	0.00
Inquiry/Response	50.00	0.00	0.00	0.00
Timesharing	30.00	0.00	0.00	0.00
USPS/EMSS	0.00	0.00	0.00	0.00
Mailbox	25.00	0.00	0.00	0.00
Administrative Messages	40.00	0.00	0.00	0.00
Facsimile	10.00	0.00	0.00	0.00
Communicating Word Processors	30.00	0.00	0.00	0.00
TWX/Telex	1.00	0.00	0.00	0.00
Mailgram/Telegram/Money Orders	2.00	0.00	0.00	0.00
Point of Sale	70.00	0.00	0.00	0.00
Videotext/Teletext	0.00	0.00	0.00	0.00
Telemonitoring Service	75.00	0.00	0.00	0.00
Secure Voice	10.00	0.00	0.00	0.00
	31.11	0.00	0.00	0.00
Network	0.00	0.00	0.00	0.00
CATV	0.00	0.00	0.00	0.00
Occasional	0.00	0.00	0.00	0.00
Recording Channel	0.00	0.00	0.00	0.00
Teleconferencing	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00

TABLE E-2. DATA ON ANALOG

PERCENT OF LONG HAUL DATA TRAFFIC CARRIED ON ANALOG

1980	1990	2000
90	67	25

TYPE OF CIRCUITS DATA TRAFFIC CARRIED

	1980	1990	2000
MTS (Business)	40	25	10
Private Line	60	75	90

AVERAGE BIT RATE OF ANALOG (KBPS)

1980	1990	2000
1.2	4.8	9.6

C - 4

TABLE E-3. DATA SERVICE PEAK HOUR CONVERSION

	Percent During Business Week 8 A.M. to 5 P.M. Monday through Friday	Number of Hours of Use	Peak Hour Factor
Data	25	5	.0002
Batch	50	5	.0004
Data Entry	95	5	.0008
Remote	85	5	.0007
Inquiry/Response	90	4	.0010
Time Sharing	90	4	.0010
USPS	80	6	.0005
Mailbox	90	6	.0006
Administrative	95	4	.0010
Facsimile	98	4	.0007
CWP	80	4	.0005
TWX/TELEX	80	4	.0005
Mailgram	80	6	.0005
Point of Sale	50	7	.0003
Videotext	75	6	.0005
Telemonitoring	30	10	.0001
Secure Voice	90	4	.0010

TABLE E.4 EFFICIENCY FACTORS

	1980	1990	2000
Data Transfer	.5000	.7000	.9000
Batch Processing	.3500	.5000	.7000
Data Entry	.0031	.0124	.0484
Remote Job Entry	.0750	.1000	.1500
Inquiry/Response	.0750	.1000	.1500
Timesharing	.0750	.1000	.1500
VBPS EMSS	.2000	.3000	.5000
Mailbox	.0031	.0063	.0126
Admin Traffic	.0031	.0063	.0126
Facsimile	.0750	.1000	.3000
Comm Word Processor	.1000	.2000	.4000
TWX/TELEX Mailgram/Telegram	.2000	.3000	.5000
Point of Sale	.0031	.0063	.0126
Video Text	.0750	.1000	.1500
Telemonitoring	.0031	.0063	.0063
Secure Voice	1.0000	1.0000	1.0000

TABLE E-5. NET LONG HAUL FORECASTS

SERVICE	YEAR		
VOICE (1000s HVCs)	1980	1990	2000
MTS (Residential)	539.6	1200.5	2636.0
MTS (Business)	1424.6	3972.4	9209.2
Private Line	556.2	2421.2	6718.3
Mobile	1.3	34.9	111.8
Public Radio	0.3	1.8	2.6
Commercial and Religious	0.5	2.0	3.2
Occasional	0.9	1.8	2.7
CATV Music	0.1	0.3	1.2
Recording	0.0	0.0	0.4
TOTAL	2523.6	7634.8	18685.5
DATA (MBPS)			
Data Transfer	43.3	97.4	354.9
Batch Processing	77.2	169.2	222.9
Data Entry	10896.1	15538.6	16006.3
Remote Job Entry	273.9	1760.3	2345.3
Inquiry/Response	305.6	2031.9	3557.9
Timesharing	243.7	538.9	707.3
USPS/EMSS	0.0	142.3	256.0
Mailbox	8.1	100.9	133.5
Administrative Messages	2607.5	8361.0	13559.2
Facsimile	541.4	947.2	720.1
Communicating Word Processors	16.6	63.8	126.2
TWX/Telex	53.2	34.9	24.0
Mailgram/Telegram/Money Orders	0.3	0.4	0.5
Point of Sale	96.3	1003.9	924.7
Videotext/Teletext	0.2	446.8	1165.1
Telemonitoring Service	0.2	0.9	4.0
Secure Voice	1.3	40.8	236.1
TOTAL	15164.9	31279.3	40344.1
VIDEO (TRANSPONDERS)			
Network	10.0	42.9	42.0
CATV	34.0	82.4	68.2
Occasional	14.3	41.6	36.0
Recording Channel	0.0	0.0	1.3
Teleconferencing	3.0	155.9	245.3
TOTAL	61.3	322.8	392.7

APPENDIX F
CPS COST ANALYSIS

F.1 CPS EARTH STATIONS DEFINITION AND COSTS

Earth stations for customer premise service (CPS) are located on a customer's premises and satisfy the customer's traffic requirement. In today's world, the business and manufacturing activities of a company are spread around the country, if not the world, and there is an extreme need to communicate among these locations. Many corporations, government departments, and institutions need communication facilities due to the diversity of their locations. Each of these entities is a candidate for a private network which can be provided by interconnecting CPS earth stations through satellite transmission facilities. To satisfy the varied traffic requirements of its customers, CPS earth stations are defined as follows:

SIZE OF EARTH STATION	CAPACITY
Large	32.0 MBPS
Medium	6.3 MBPS
Small	1.5 MBPS
Mini	64.0 KBPS

The capacities of these earth stations are consistent as defined by NASA in their RFP (1) for SS-FDMA Ka-band studies and the various CPS studies currently being conducted.

F.1.1 C-band Earth Station Costs

Various earth station component suppliers were contacted and estimates on various earth station components were obtained. The estimates did vary between suppliers.

F.1.1.1 Antenna Subsystems

The costs for antenna subsystems are given in Table F-1 (tables follow figures at the end of this Appendix). The large antennas include the cost of tracking and frequency reuse. Frequency reuse is included as all the new generation C-band satellite systems use dual polarization.

F.1.1.2 Low Noise Amplifier (LNA) Costs

C-band LNA costs for nonredundant and redundant units are given in Table F-2. The redundant unit includes the cost of automatic switching between the two LNAs.

F.1.1.3 High Power Amplifier (HPA) Costs

The C-band high power amplifier costs are presented in Table F-3. The costs of TWT HPAs and klystrons are also presented. TWT HPAs offer a wide bandwidth as compared to klystrons. In some applications, use of klystrons is not desired due to the large bandwidth requirement.

F.1.1.4 Upconverters

The C-band up and downconverter costs are presented in Table F-4.

F.1.1.5 Ground Communications Equipment

F.1.1.5.1 TDMA Terminal Costs

Various vendors were contacted and TDMA terminal costs for full transponder TDMA equipment (60 MBPS) as well as costs for partial transponder TDMAs were obtained. These costs are listed in Table F-5 for redundant and non-redundant TDMA terminals.

F.1.2 C-band Earth Station Costs

F.1.2.1 Large Earth Stations

According to the RFP standard, earth stations are to be designed with availabilities of .995 and .999 respectively. For existing C-band satellites, it is cost effective to provide 32 MBPS, by using a full transponder 60 Mbps TDMA approach. The uplink and downlink burst rates are 60 MBPS.

A typical C-band large earth station consists of an 11 meter antenna, 50° LNA and 3 KW HPA. The .995 availability can be satisfied with a single thread earth station. The .999 availability requires all components to be redundant. The typical single thread earth station and redundant earth station are shown in Figures F-1 and F-2, respectively. The costs are indicated in Table F-6.

Since the transmission approach used here is TDM/TDMA, this earth station could be used for small, medium, or large earth stations.

F.1.2.2 Medium and Small Earth Stations

For medium and small earth stations, depending on the total network capacity requirement, it may be more cost effective to use the partial transponder TDMA approach. The earth station considered here is a partial transponder earth station with 15 MBPS burst rate for uplink and downlink. For 99.5% availability, a typical 15 MBPS burst rate earth station will consist of a 7 meter antenna, 50° LNA and 600 watt HPA with all RF components being non-redundant. For .999 availability, all RF components (except antenna) are redundant. TDMA common equipment used is also redundant. Typical costs are presented in Table F-7.

It should be noted that the number of carriers which could be accomodated per transponder is 2.15 Mbps carriers. Hence the total transponder capacity is 30 MBPS in this case.

F.1.2.3 Small and Mini Earth Stations

Again, depending on the total CPS network capacity requirement, it may be more cost effective (see Table F-8) to use partial transponder TDMA earth terminals with 8 MBPS as the burst rate. With this arrangement, one could accomodate three carriers per transponder with a 7 meter antenna, 100° LNA and 300 watt HPA. For .995 availability, a single thread earth station is used. For .999 availability, a fully redundant earth station is used. The transponder capacity in this configuration is 24 MBPS.

F.1.2.3.1 SCPC Approach (Digital Carrier)

Costs for the TDMA approach have been presented in previous sections. For small and mini earth stations, pricing is also done using the single channel per carrier (SCPC) approach. Earth stations with this approach tend to be smaller and more cost effective. They also provide the opportunity to tailor the traffic requirement to the size of the earth station. The link budget summary for 1.5 MBPS SCPC is presented in Table F-9 and Table F-10. Table F-9 shows that for 1.5 MBPS, if a small earth station using a 5 meter antenna is used, one can only have three 1.5 MBPS SCPC carriers per transponder; whereas if one uses a 7 meter antenna, seven 1.5 MBPS SCPC carriers can be transmitted per transponder. The single thread earth station is used for .995 availability. A fully redundant earth station is needed for .999 availability. The power requirement for a 7 meter antenna is 15 watts, whereas for a 5 meter antenna it is 40 watts. The costs for a 5 meter earth station with .995 and .999 availability are presented in Table F-11; the costs for a 7 meter earth station are presented in Table F-12.

A 5 meter earth station can support 155 VF carriers whereas a 7 meter antenna can transmit about 309 VF carriers, as seen in Table F-10. The performance requirement for 64 KBPS carriers, to be used for voice is assumed to be at a Bit Error Rate (BER) of 10. The cost of .995 and .999 availability is given in Table F-13. For .995 availability, single thread earth stations are required; for .999 availability, a fully redundant earth station is required. The cost of a 7 meter 64 KBPS SCPC earth station is tabulated in Table F-14.

1.2.3.2 SCPC (Analog Approach) For Single VF Carrier

For mini terminals, analog SCPC is considered. The relationship for signal to noise (S/N) ratio versus carrier to noise ratio (C/N) is given as follows:

$$\frac{S}{N} = \frac{C}{N} + 10 \text{ Log } \left(3 \frac{F^2}{Fm^2}\right) + 10 \text{ Log } \left(\frac{BIf}{2Ba}\right) + W + C$$

Where:

F	=	peak channel frequency deviation
Fm	=	highest baseband frequency
Ba	=	audio noise bandwidth equal to Fm
BIF	=	IF noise bandwidth (30 KHz) for commercially available equipment
W	=	Emphasis plus weighting improvement factor of about 6.5 dB
C	=	Compounding advantage of about 17 dB

Noise Channel Objective
CCIR recommended noise objective is 1 X 10^4 (picowatt psophometrically weighted referenced to OTLP). This is equivalent to S/N of 50 dB.

The SCPC earth station with S/N of 50 dB, i.e., C/N 8 dB (for detection, the threshold C/N requirement with threshold extender demodulation is 11 dB), will consist of a 5 meter antenna, 100° LNA and 5 watt TWT. For .995 availability, single thread earth stations are required; a fully redundant earth station is desired for .999 availability. The costs of .995 and .999 availability analog VF earth stations are presented in Table F-15. The number of single VF channel carriers per transponder is 60.

F.1.2.4 Summary

Table F-16 summarizes the cost for various types of earth stations as given in Section 1 for .995 and .999 availability.

F.1.3 Ku-band Earth Station Costs

Various Ku-band earth station component suppliers were contacted and estimates on various components were obtained.

F.1.3.1 Antenna Subsystem

The costs for antenna subsystems are given in Table F-17. Ku-band antenna costs are higher than the corresponding C-band antenna costs for various reasons, among them:

- The surface tolerance requirement for Ku-band frequencies is more stringent than that required in C-band.
- C-band satellite systems have existed for commercial applications for about a decade so the manufacturing process is more streamlined.

F.1.3.2 Low Noise Amplifier Costs

The cost of 150° LNA for Ku-band is 21K dollars for nonredundant units, whereas the redundant unit costs about 50K dollars. These figures are given in Table F-18.

F.1.3.3 High Power Amplifier Costs

The Ku-band high power amplifier costs are presented in Table F-19.

F.1.3.4 Converter Costs

The Ku-band up and downconverter costs are presented in Table F-20.

F.1.4 Ku-band Earth Station Costs

Earth stations, according to the RFP, are to be designed with the availabilities of .995 and .999 respectively. The satellite parameters used for earth station design are:

Satellite EIRP at Saturation	43.5
Satellite G/T	1.6 dB/°K
Transponder Bandwidth	54 MHz

The propagation path availability of .996 is required for overall availability of .995; whereas the propagation availability of .9992 is enough for .999 end-to-end availability. Uplink and downlink margins for various zones at .996 and .9992 availability are presented in Table F-21. Zones of the U.S.A. appear in Figure F-3.

F.1.4.1 Large Earth Stations

The capacity requirement for a large earth station is 32 MBPS. Table F-22 outlines the link budget for a TDMA earth station with a burst rate of 60 MBPS. A 5.5 meter antenna earth station satisfies the alternation requirement of .996 propagation availability, whereas a 7.7 meter antenna is required for Rain Zones 1, 2, and 3 for the higher propagation availability. Rain Zone 4 requires a bigger earth station with an 11 meter antenna.

For .995 availability, a typical earth station consists of a 5.5 meter antenna, 50 watt HPA and a 150° LNA. For .999 availability, the earth station consists of a 7.7 meter antenna with 40 watt HPA and a 150° LNA for Rain Zones 1, 2, and 3. For Rain Zone 4, the earth station consists of an 11 meter antenna with an HPA of 300 watts and a 150° LNA. Earth station costs are tabulated in Table F-23. The TDMA equipment for Ku-band will cost the same as C-band TDMA equipment.

For .995 availability, a single thread earth station is used, excepting a redundant HPA since meantime between failure (MTBF) for a Ku-band HPA, is lower than that for a C-band HPA. For .999 availability, a fully redundant earth station is needed.

F.1.4.2 Medium and Small Earth Stations

TDMA is used for large earth stations. Depending on the network traffic requirement, the same earth station can also be used for medium and small earth

stations. However, if the total capacity requirement is low, one can then use the partial transponder TDMA approach. The burst rate used is 15 MBPS for both uplink and downlink. Table F-24 presents the link budget summary for 15 MBPS burst rate earth stations.

It is shown that for .995 availability a typical earth station will consist of a 5.5 meter antenna, 300 watt HPA and 150° LNA. It is a single thread earth station with the exception of the HPA. The transponder can support three 15 MBPS carriers. For .999 availability the earth station consists of a 7.7 meter antenna, 300 watt HPA and 150° LNA for Rain Zones 1, 2, and 3. The earth station is fully redundant. For Rain Zones 3 and 4, an 11 meter antenna is needed. Costs for earth stations with .995 and .999 availability are presented in Table F-25.

F.1.4.3 Small and Mini Earth Stations

Depending on the total CPS network capacity requirement, it may be more cost effective to use partial transponder TDMA earth stations with 8 MBPS burst rates. With this arrangement, one could accomodate five 8 MBPS carriers.

The up and downlink budget is summarized in Table F-26.

A typical earth station for .995 availability will consist of a 7.7 meter antenna, a redundant 300 watt HPA and a 150° LNA, whereas the 8 MBPS earth station for .999 availability will require an 11 meter antenna for Rain Zones 1, 2, and 3; for Rain Zone 4 a 13 meter antenna is needed. Table F-27 presents the costs for 8 MBPS burst rates for .995 and .999, respectively.

F.1.4.3.1 SCPC Approach (Digital Carriers)

The link budget summary for 1.544 MBPS SCPC carrier earth stations is shown in Table F-28. Table F-29 presents the link budget for 64 KBPS SCPC earth stations.

F.1.4.3.1.1 1.5 MBPS SCPC Earth Station

A typical earth station for .995 end-to-end availability consists of a 5.5 meter antenna, 25 watt HPA and 150° LNA. For .999 availability, a 7.7 meter earth station with 10 watt HPA and 150° LNA is required for Rain Zones 1, 2, and 3. For Rain Zone 4, an 11 meter antenna is required. For .995 availability, single thread earth stations with redundant HPA are required, while for .999 availability, fully redundant earth stations are necessary. The costs are outlined in Table F-30. The Ku-band transponder will support 16 T1 carriers.

F.1.4.3.1.2 64 KBPS SCPC Earth Station

For .995 availability, a typical earth station consists of a 5.5 meter antenna, with 5 watt HPA and 150° LNA. It is a single thread earth station.

For .999 availability, a typical earth station is fully redundant with a 7.7 meter antenna for Rain Zones 1, 2 and 3; an 11 meter antenna is required for Rain Zone 4. The Ku-band transponder will support 562 SCPC (64 KBPS) carriers. The costs for 64 KBPS SCPC earth stations are presented in Table F-31.

F.1.4.4 Ku-band Earth Station Cost Summary

Costs for various types of earth stations have been summarized in Table F-32. It is seen that for .999 availability, a larger sized antenna in conjunction with a fully redundant earth station is needed. Rain Zone 4 will need an antenna which is larger as compared to Rain Zones 1, 2, and 3. Hence, the cost of earth stations in Rain Zone 4 is higher than the cost of earth stations in Rain Zones 1, 2 and 3 for an availability of .999.

F.1.5 Ka-band Earth Station Costs

30/20 GHz Satellite systems are not presently available as they are still in the planning phase. NASA is formulating a new policy which will encourage the private sector to participate in many technical developments involving multiple antenna beams, frequency reuse techniques, on-board switching, and signal

processing among other things which will be useful at all frequency bands used for satellite communications. Even though these technical developments are for all satellite frequency bands, these technologies are also the driving force behind development of 30/20 GHz or higher frequency satellite systems. These technical developments are necessary to overcome the large rain-induced attenuation at these extremely high frequency (EHF) bands.

The sizing and transmission approach used in earth station design depends on the spacecraft configuration (i.e., SS-TDMA, SS-FDMA or Hybrid) and the spacecraft parameters, (i.e., Effective Istropic Radiated Power (EIRP) of the transmit beam and the satellite receive gain to system noise temperature G/T of the receive beam). Satellite parameters used for earth station design are given in Table F-33. Table F-33 also shows the uplink and downlink rates for several types of CPS earth stations presented in Paragraph 1.

F.1.5.1 Margin Requirements

Figure F-4 shows the rain rate climate regions for the continental United States (CONUS). Figure F-5 demonstrates the point rain rate distribution as a function of the CONUS rain regions. Region D is subdivided into three subzones and the rain rate distribution for each of the subzones appears in Figure F-6. Using the procedures from the NASA handbook, fade depths were calculated in Referencr 4. For the sake of convenience, the rain attenuation requirement for various zones is presented in Table F-34.

F.1.5.2 Large CPS Earth Stations

The transmission design approach used is that given in Section 1.5. A typical link budget summary for a large TDMA earth station is presented in Table F-35. Uplink and downlink burst rates are 128 MBPS and 256 MBPS respectively. A typical 32 MBPS earth station consists of a 5 meter antenna and a 10 watt HPA, with an earth station G/T of 27.8 dB/°K. Clear weather margins for uplink and downlink are 5.3 dB and 11.8 dB, respectively.

To meet the availability objective, the Ka-band CPS systems will require the use of adaptive power control (APC) and forward error control (FEC). For CPS

system rates, ½ encoding with soft decision decoding will provide an 8.8 dB coding gain at a constant transmission rate.

Table F-36 presents a summary of link margins and availability achievable in clear weather, clear weather plus adaptive FEC and margins achievable both with FEC and adaptive power control. From Table F-36, it is seen that for the large earth stations, FEC is not enough to give an end-to-end .999 availability (class 1) in rain zones D_2, D_3 and E. If an adaptive power control is implemented in addition to FEC, an end-to-end .999 availability is achieved for large CPS stations in all rain zones excepting Rain Zone D_3 and E. With FEC and power control an end-to-end .995 availability, (class 2) is achieved in all zones except Zone E.

F.1.5.3 Medium and Small Earth Stations

For medium and small earth stations, as presented in Table F-33, the uplink and downlink burst rates are 32 MBPS and 128 MBPS, respectively. Table F-37 presents the uplink and downlink budget summary for the station under consideration. The typical medium and small earth station consists of a 3 meter antenna, 10 watt tube and system G/T of 24 dB/^{o}K. The uplink and downlink margins are 5.2 dB and 11.2 dB. With FEC and adaptive power control, an end-to-end availability of 0.995 can be achieved in all zones except E. An end-to-end availability of 0.999 can be achieved in all zones except D_3 and E.

F.1.5.4 Mini Earth Stations

For mini earth stations with a capacity of one voice channel, the uplink burst rate is 8 MBPS, while downlink burst rate is 128 MBPS. The uplink and downlink budget is summarized in Table F-38. The typical mini earth station consists of a 2 meter antenna, 10 watt tube and a system G/T of 20.5 dB/^{o}K. With FEC and adaptive power control, an end-to-end availability of 0.995 can be achieved in all zones except Zone E. An end-to-end availability of 0.999 can be achieved in all zones except D2, D3, E.

No further rain margins would be useful since polarization isolation degrades to an unacceptable level in rain fades in excess of the maximums shown. Greater availabilities or access by Zone E could be accomplished through station diversity.

F.1.5.5 CPS Earth Station Costs

Table F-39 presents the costs of Ka-band earth stations. The FDMA examples include two cases which depend on spacecraft antenna beamwidth. It should be noted that these costs also include installation and integration costs. These costs were computed (Reference 7) for an availability of .995 in all but Rain Zone E (CCIR Rain Model) and .999 in all except D3 and E.

F.1.5.6 CPS Earth Station Costs (.999 Availability) in Rain Zone E.

The only way to achieve .999 availability in rain Zone E is to have space diversity. In all cases the extra terminals and interconnects make costs prohibitive.

F.1.6 References

(1) NASA RFP Number 3-870744 entitled "Satellite Switched FDMA Communications System for Customer Premise Service."

(2) "Customer Premise Service Study for 30/20 GHz Satellite Systems," by TRW dated February 4, 1982.

(3) "CPS Study for 30/20 GHz Satellite Systems Space Segment Concepts," presented by TRW at the NASA Industrial Briefing, dated April 20-21, 1982.

(4) "Task Report 30/20 GHz Communication Systems Functional Requirements," prepared by Western Union under NASA Contract Number NAS3-22461, Task 1.

(5) "Customer Premise Service Study for 30/20 GHz Satellite Systems," GE Interim Report, NASA Contract NAS3-22890, dated January 13, 1982.

(6) "Analysis and Application of Japanese Satcom Orbital Test Results in the 30/20 GHz Band---," prepared by Ford Aerospace and Communication Corporation (FACC) under NASA Contract NAS3-21501.

(7) Private Communication with G. Stevens of NASA.

F.2 CPS SPACE SEGMENT COST

In costing end-to-end service costs, the other major component is the cost of space segment. The three types of space segments considered here are C-band space segment, Ku-band space segment, and Ka-band space segment. The approach for estimating the C-band space segment cost was to use the actual costs which were associated with one of the newer generation satellites launched by Western Union (WESTAR IV). This satellite represents the state-of-the-art C-band satellite and it seems all C-band satellites launched recently or planned for launch are similar to WESTAR IV.

The approach used for estimating the Ku-band space segment cost was to examine the various Ku-band "FCC filings" made for various Ku-band satellites.

For Ka-band space segment cost NASA provided costs are used.

F.2.1 C-band Satellite

The typical C-band satellite technical characteristics are presented in Table F-40. Table F-41 gives the representative spacecraft weight-budget and Table F-42 gives the center frequency assignments of the 24 transponders for uplinks and downlinks.

A typical C-band satellite comprises of 24, 36 MHz wide transponders. It uses horizontal and vertical polarization. Figure F-7 illustrates the typical C-band communication systems. Space segment costs consist of the following cost elements:

a. Satellite develoment cost
b. Recurring satellite cost
c. Launch costs
d. TT&C and satellite control center costs
e. Operation and maintenance costs.

For C-band satellite it is assumed there is no development cost associated since they are becoming standardized.

By examining the costs associated with WESTAR IV and looking at various FCC filings the cost estimates are as follows for C-band satellite:

Cost of a C-band satellite including launch and insurance and other overhead	= 78 million $
Telemetry tracking and command (TT&C) and Satellite control center costs	= 15 million $
Operation and maintenance cost per year	= 1 million $
Cost of c-band satellite	= 30 million $

- Launch cost approximately 30 million dollars. Insurance cost is 9 million dollars.

For a typical satellite system it is assumed that to begin two satellites will be launched and one will be a ground spare. The initial investment (I) is then:

$$I = N(R+L+IN) + R + NR + TT + C$$

where N = Number of satellites launched

R	=	Recurring cost for a satellite (refers to ground spare as well as in-orbit satellite)
L	=	Launch costs
IN	=	Insurance cost of a satellite
NR	=	One time development or non-recurring cost
TT&C	=	Cost associated with TT&C and satellite control centre

For a C-band system

= $201 million

This does not include the operation and maintenance cost.

F.2.2 Ku-band Satellite Costs

In C-band satellite systems, more or less a typical satellite has emerged, but in Ku-band satellite systems, various types of satellites are being planned. The SBS Ku-band satellite uses single polarization and is comprised of 10, 48 MHz wide transponders, whereas "GTE" uses dual polarization and "GSTAR" is comprised of 16, 54 MHz wide transponders. The Southern Pacific's satellite is hybrid, using both C-band and Ku-band transponders. Ku-band transponder is 72 MHz wide. For the purpose of this study Ku-band satellite similar to GTE will be assumed. Table F-43 summarizes the primary operational characteristics of the satellite; while Table F-44 gives the representative spacecraft weight budget.

Functional block diagram of Ku-band dual polarized, satellite repeater is shown in Figure F-8 with eight vertical and eight horizontal polarized transponders. The cost elements of space segment are the same as outlined in Paragraph 2.1. The costs for these elements are given below:

Development	34 million $
Cost of satellite including launch	70 million $
Telernentry tracking and command (TT&C) and satellite control center	15 million $
Cost of Ku-band satellite	35.7 million $
Operation and maintenance	1 million $
Cost per year insurance cost	11.9 million $

For a typical satellite system, two satellites will be launched and one will be a ground spare. Insurance cost is about 17% of the total satellite and launch cost. The initial investment is 248.5 million dollars. The operation and maintenance cost per year is one million dollars.

F.2.3 Ka-band Space Segment for CPS Systems

The Ka-band space segment for CPS systems may be configured using following approaches:

a. TDMA
b. FDMA
c. Hybrid.

For hybrid space segment, the uplink uses FDMA approach, while downlink uses TDM approach. The characteristics (a possible set) of three GBPS and five GBPS CPS System using the above approaches are presented in Table F-45 (Ref 6), while Table F-46 presents the weight and power estimates by 30/20 Ghz CPS Systems spacecraft. Figures F-9, F-10, and F-11 present the Ka-band CPS TDMA communication payload, CPS FDMA payload, and CPS hybrid communication payload respectively. The costs of the Ka-band space segments are presented in Table F-47. For a typical Ka-band satellite system it is assumed that one satellite is launched and one will be a ground spare.

F.2.4 C, Ku-band Transponder Price

The total investment for C-band satellite systems as estimated in Section 2.1 is 201 million dollars with yearly operational and maintenance expenditures of 1 million dollars. The price per transponder is estimated using the model shown in Figure F-12. The "WU" proprietary financial package was used to determine the estimate of all loadings and profits for the life of the system. Figure 12 also shows the price per C-band transponder for eight and ten year system life. It is seen that the transponder price per year is 1.81 M for eight year life cycle, whereas for ten year life cycle the price is 1.70 million/year. Western Union presently leases the C-band transponder for 2 million dollars/year.

Figure F-13 shows that Ku-band transponder price is 3.43 M/year for eight year life cycle, whereas for ten year system life the price is 3.21 M dollars/year.

It should be noted that in both C and Ku-band it has been assumed that as soon as the satellites are launched, half of the transponders will be used. The demand for remaining transponders will grow linearly through the life of the satellite, i.e., on the average three-fourths of the number of transponders will be used.

F.2.5 Ka-band Equivalent Transponder Price

A typical C-band transponder can transmit 60 MBPS. The equivalent number of transponders per Ka-band spacecraft for 3 GBPS, 5 GBPS and 10 GBPS capacity are 50, 83 and 166 respectively. In computing the price per equivalent transponder the following assumptions are made:

a. The average life expectancy for the spacecraft is ten years
b. The average capacity in use at any time is 0.5
c. The space segment system will consist of an in-orbit satellite and one ground spare.

The cost of TT&C (MCF) system is assumed to be 40 million dollars. The operation and maintenance cost for each system is assumed to be 2 million dollars per year.

Initial investment of the system is calculated as the summation of the following factors:

a. Launch + satellite cost
b. Insurance cost
c. TT&C and control center cost
d. Operation and maintenance cost per year.

Table F-48 summarizes the initial investment cost for three GBPS and five GBPS capacity spacecraft with various approaches.

Figure F-14 presents the equivalent transponder cost model for Ka-band three GBPS and five GBPS capacity, along with the price estimates per equivalent transponder for TDMA space segment approach.

F.2.6 REFERENCES

1. Memo from C. Bhushan to J. Lekan dated May 5, 1982.
2. Memo from J. Lekan to C. Bhushan received May 18, 1982.
3. Private communication with Mr. Grady Stevens of NASA.
4. "Customer premise service study for 30/20 GHz satellite systems," Third Interim report by TRW dated February 4, 1982.
5. Presentation by Grady Stevens at NASA industrial facility.
6. "CPS Study for 30/20 Ghz satellite systems space segment concepts," presented by TRW at NASA industrial facility April, 1982.
7. B. I. Edelson et al, "Greater message capacity for satellites," IEEE Spectrum March, 1982.
8. "30/20 Ghz mixed used architecture Development Study."

F.3 TERRESTRIAL TRANSMISSION SYSTEMS

F.3.1 Digital Radio Transmission Systems

F.3.1.1 Introduction

Digital Microwave Systems have become an important alternative for the transmission of voice and data in a relatively short time. The picture has changed rapidly since the adoption of FCC dockets 18920 (on local distribution) and 19311 (on digital radio) in 1974. The reason for change was mainly due to the significant cost reduction and performance improvement that could be obtained in the total telephone system when digital techniques were used. Today, digital transmission systems are widely used throughout this country's telephone system.

F.3.1.2 Modulation Technique

Modulation techniques for digital radio systems have undergone much the same evolution as have modulation techniques for voice-band modems. Early systems used QPSK to achieve efficiencies of approximately 1 BPS per hertz. To meet the capacity required by the FCC, higher level schemes were needed. For 45 and 90 Mbps systems operating at spectrum efficiencies of 2.25 to 3.00 BPS per hertz, 8 PSK and 16 QAM are the most widely used techniques. The signal constellation for these techniques are shown in Figure F-15. The signal constellations are plotted on an equal power basis and the distances between each point and its nearest neighbor are a reflection of the relative signal-to-noise ratio required for a given bit error rate. From these plots, it is evident that 8 PSK is the most rugged technique, however, it requires the widest receive filtering and, therefore, has less adjacent channel selectivity than techniques such as 16 QAM. In general, the higher the level of modulation technique used, the poorer the inband performance will be and the better the out of band performance will be. Comparison between modulation technique is well known and covered extensively in textbooks.

F.3.1.3 Digital Processing

The digital processing portion of a digital radio system is made up of several functions. At terminal locations, there is generally a high speed multiplexing function to combine one or more traffic data stream with other data signals before transmission. This is normally accomplished through positive pulse stuffing which allows the radio clock rate to be controlled independently from the clock in the digital traffic stream. It also removes any requirements for synchronization between the various traffic data streams if the radio can accept more than one stream.

Another function added to the digital stream at terminals before transmission is a radio frame structure. This frame structure is required if pulse stuffing has been done so that the location of the stuffed bits can be identified and removed to reconstruct the original traffic data stream at the receive end. The radio frame structure also provides a valuable piece of information for system

monitoring in that it serves as a signal continuity monitor between the transmit and receive terminal.

When the frame structure for a radio is designed, there are often additional bits added to the radio stream for auxiliary channels. These auxiliary channels are used for voice communications by maintenance personnel and for various fault monitoring and system control functions. These channels are usually accessible on a terminal to terminal basis and also at repeater locations along the way. Figure F-16 shows a digital radio block diagram.

F.3.1.4 System Costs

The costs are based on the assumptions outlined below:

a. Digital systems will be designed using solid-state duplex protected microwave radio with a capacity of 1344 digitized voice channels.
b. Single antenna system using ellipitical waveguide will be used throughout.
c. Fault and alarm system will be tied to an existing master station. Costs for remote control operation is included at terminals.
d. A typical 5 KVA diesel engine generator with automatic switching is included at city terminals and 10 KVA at repeaters.
e. City sites will be leased and no land costs are included.
f. Prefabricated building will be used at all repeater locations.
g. Civil work and land estimates are based on average costs. Actual costs will vary consideraly from site to site.
h. Single polarization scheme with standard RF branching configuration is priced in.
i. Average test equipment costs are included for city terminals and repeaters.

Tables F-49, F-50 and F-51 show digital radio terminal, repeater and multiplex equipment. From these tables, the cost of a radio system, fully equipped down

to the channel level was worked out, was fed to the computer and annualized costs per channel are tabulated (see Table F-52) to show the variations of costs with distance.

F.3.2 Optical Fiber Systems

F.3.2.1 Introduction

There is no doubt that optical transmission and glass fibers will become a dominant transmission technology in the future. The use of fiber optics provides an unlimited number of channels by virtue of being a cable medium, and provides superior economics by virtue of low loss and wide bandwidth.

Today, fiber optics technology has already reached the state of full-scale production and wide application for short and long haul trunking. This application is founded on a body of theoretical and practical knowlede developed in the last twenty years.

F.3.2.2 Selection of Operating Wavelength

The factors to be considered in selecting the proper operating wavelength are optical fiber loss, equipment system gain, optical fiber bandwidth, and economics (first cost versus life-cycle cost).

a. Optical Fiber Loss Versus Wavelength
Figure F-17 illustrates the attenuation (in dB/km) for high-grade telecommunications optical fibers as a function of operating wavelength (in nanometers). The attenuation decreases rather uniformly from over 6 dB/km at 700 nm to a minimum (under 0.7 dB/km) near 1300 nm. The larger increase in attenuation at 1400 nm is due to the presence of hydroxyl (OH) ions in the glass. The natural resonant frequency of these ions is approximately 2700 nm and significant light energy is absorbed by these ions at harmonics of this fundamental frequency (corresponding to wavelengths of approximately 1400

and 900 nm). The attenuation comes to another minimum near 1500 nm. The optimum wavelength for minimum attenuation in the optical fiber would be near 1300 or 1500 nm.

b. Equipment Gain Versus Operating Wavelength

The early lightwave transmission systems did not operate at either 1300 or 1500 nm, however. These first systems operated at approximately 850 nm. The reason for this was the technology for optical sources and detectors was limited to the 850 nm region. The material used in manufacturing the semiconductor laser diodes (galium aluminum arsenide (GaA1As)) caused the lasers to emit light in the 850 nm region. This was just below the third harmonic of the natural resonance of the hydrozyl ions in the optical fiber and, therefore, avoided the increased absorption of light energy at 900 nm. The system gain achievable with GaA1As lasers and avalanche photodiodes is approximately 47 dB.

Current technology is utilizing indium galium arsenide phosphide (inGaAsP) in the manufacture of sources and detectors at 1300 nm. The yields in the manufacturing process are still very small compared to the 850 nm lasers and, therefore, are much more expensive. The cost of these long-wavelength devices should approach that of the short-wavelength devices within the next few years.

Devices in the 1500 nm range are still undergoing development in the laboratory. Production devices are still a few years in the future.

Despite the reduced system gain, long-wavelength systems can operate over much longer spans than short-wavelength systems because the optical fiber loss is approximately 1.3 dB/km less for the long-wavelength case.

c. Optical Fiber Bandwidth Versus Wavelength

Figure F-18 shows the relationship between optical fiber bandwidth and wavelength. The bandwidth characteristics of optical fibers are nearly identical at 850 and 1300 nm. The fact that spans utilizing long-wavelength technology can be longer than

those utilizing short-wavelength technology causes bandwidth to become a much more important issue.

d. Economics of Operating Wavelength

The long-wavelength optical devices are more expensive, making the equipment about 20 percent more expensive. The optical fiber must be better (and therefore more expensive) to make up for the reduced system gain at 1300 nm. At the present time, 1300 nm cable is about 20 percent more expensive than 850 nm cable of the same performance characteristics. The system cost for a 1300 nm system would exceed the cost of 850 nm system by 20 percent with no compensating advantages for short haul systems (less than 10 km).

Suppose, however, that the span length is beyond the 14.5 km (9.0 mi) maximum span distance for a short-wavelength span. Assuming that the span is 20 km (12.4 mi), if we are to design a short-wavelength system, we would have to make provisions for a repeater and design two 10 km (6.2 mi) spans. The cable cost would be less for the short-wavelength solutions, but nearly twice as much equipment would be required. Further, we would have to make provision for a repeater location with power, environmental control, security, etc., for the life of the system. The long-wavelength system design would not require a repeater location, as it could accommodate a span distance up to 27.5 km (17.1 mi) without a repeater. Clearly, the 20 percent premium in cost for a long-wavelength system is more than compensated by the savings in repeaters and repeater locations. Further savings can be attributed to the nonrepeated system when considering the life cycle costs of maintenance, taxes, operating expenses and reliability.

F.3.2.3 Link Loss Budget Calculations

The elements of a link loss budget involve the intrinsic loss in the optical fiber, splice losses, connector losses, system degradations, and operating margin.

a. Intrinsic Loss of the Optical Fiber

The intrinsic loss of the optical fiber is the major component of a link loss budget. Intrinsic loss is caused by absorption in the fiber core, scattering, and some losses in the cladding. This loss is generally expressed in terms of dB/km and varies depending on the process used to manufacture the fiber and the process used to cable the fiber into a completed cable for duct, direct bury, or aerial applications. The cabling techniques vary in their ability to buffer the optical fibers from the stresses applied to the overall cable. Unrelieved stresses on the fiber cause increased attenuation.

b. Splice Losses

The splice losses are generally in the 0.30 dB per splice range. The cable vendors will specify the splice loss as a part of the end-to-end loss in order to spread the losses over the entire span. If the cable vendor can supply cables in lengths of 2 km (1.2 mi), the splice loss becomes 0.15 dB/km. The most efficient and economic design technique is to have the cable vendor quote the end-to-end loss for each span (including splices) in the ground. The cable vendors will guarantee the cable performance even if the cable is installed by telephone company personnel under the cable vendor's supervision.

c. Connector Losses

Most manufacturers provide connectorized interfaces to the lightwave transmitters and receivers. They do not uniformly account for the losses included. That is, the transmitter power specified is the power launched into the fiber at the output connector. Similarly, the receiver threshold is specified as the energy delivered to the connector on the lightwave receiver. Some manufacturers, however, specify the guaranteed levels so that no additional allowance for "typical" performance is required.

d. System Degradations

Conservative system design requires that there be an allowance in the link budget for system related noise Phenomena such as

nodal noise that will not appear in back-to-back performance thrugh optical attenuators. These system degradations are analogous to waveguide echo distortion or nonlinear passband distortion such as is caused by multipath fading in digital microwave radios. Research continues to further define these noise mechanisms in order to minimize their effects. In the meantime, we must allow for them in the link loss budget calculations.

The output power of the transmitter must be maintained at full output to realize the advertised system gain. If it decreased by a few dB before an alarm is tripped, there must be an allowance of those few dB in the link loss budget in the event the power reduced, but not sufficiently to trip the alarm.

Another system degradation comes from the need to trade off system gain for bandwidth. If a system becomes bandwidth limited, it is possible to operate a system at a bandwidth less than the specified value. Operating with a bandwidth below this value will cause intersymbol interference, and will reduce the receiver threshold proportionately.

e. Wavelength Division Multiplexing (WDM) Allowance in a Link Loss Budget

Long-wavelength systems will tend to be bandwidth limited until a single mode fibers become economically feasible. An effective way to increase bandwidth capacity of 1300 nm systems is to multiplex more than one optical signal onto the fiber. Wavelength Division Multiplex (WDM) devices are available today that will multiplex two or more optical signals onto a single fiber. These devices are basically prisms that "bend" the light from two or more input ports toward a single output port. Present devices introduce insertion loss of 3 dB per end, which gives a total of 6 dB per fiber. New techniques are being developed to reduce this loss to 2 dB per end for a total of 4 dB per fiber.

f. Operating Margin in a Link Loss Budget

Operating margin is the margin placed in the link loss budget by the operating company to allow for future splices required

because of cable breaks and allowance for other degradations over time. The amount of margin should depend on the physical environment and the likelihood that the cable will be cut. A minimum of 3 dB is recommended.

Figure F-19 shows a 90 MBPS optical fiber system block diagram.

F.3.2.4 System Costs

The cost of fiber optic transmission systems at each terminal is based on two M13 multiplexers, including redundant common equipment, two 90 MBPS optical terminals (one main and one spare) with 1 x 1 protection switching and all the required alarms and power distribution panels. The repeater is placed at a distance of 25 km from each terminal and housed in a weatherproof enclosure which includes charger and standby batteries sufficient for eight hours of standby power. A typical 5 KVA diesel engine generator with automatic switching is included at city terminals.

The cable to be used is of premium quality with attenuation less than 1 dB/km at 1300 nm and has an end-to-end dispersion of less than 6 ns. The cable consists of four fibers, one fiber working and one spare for each direction of transmission.

Table F-53 shows the costs for hardware and cable including installation. The optical fiber cable installation is assumed to be as follows:

City Terminal

3 km through large city ducts

2 km through suburb ducts

Repeater Location

5 km through suburb ducts in each direction. The rest of the cable will be through rural area, i.e., trenching.

Table F-54 shows the annual cost per channel using a 90 MBPS fiber optic system and how these costs vary with distance.

Tables F-55 and F-56 represent the annual user to use cost per channel assuming that the users are within three miles radius from the central office. All users circuit costs are based on the present tariffs. Voice frequency costs are based on the average tariff of Category A and Category B.

F.3.3 Technology of Future Systems

F.3.3.1 Introduction

Some of the important advances in digital transmission in the years ahead will include increased capacity through the use of new modulation systems and data compression schemes; increased span length in fiber optic systems; new services including digital video; and significant equipment improvements make possible by the use of new devices.

The major system technologies to be discussed are: high capacity digital radio and time assigned speech interpretation.

F.3.3.2 High Capacity Digital Radio

Present capacity of digital radio is two DS3 (44.786 MBPS) rate in the standard North American traffic interface. The logical next step is to increase the capacity of the future digital radio in DS3 increments i.e., future radio will have a cpacity of three DS3 by 1990 and four DS3 by the year 2000. Other factors which must be considered for higher capacity digital radio are the regulatory constraints on occupied RF bandwidth, spectrum shape and bandwidth utilization, the complexity of the modulation technique and its effect on obtaining acceptable performance system parameters.

It is apparent that future higher capacity digital radio systems will utilize combinational modulation techniques with efficiencies of 4.5 to 6 bits per second per Hz. This implies that the systems will use linear transmitter structures. To achieve these efficiencies, high level QAM techniques will be required. Figure F-20 shows the channel capacity for various modulation schemes.

It is clear that the higher channel capacity will impact the cost per channel per year. It is anticipated that the cost per channel per year will drop by 25 percent in 1990 and 15 percent in 2000. Table F-57 shows the variations of costs with distance.

F.3.3.3 Time-Assigned Speech Interpolation (TASI)

The use of TASI permits an increase in the voice channel capacity of a digital transmission system. TASI, originally designed for analog submarine cable operation, is well suited to digital voice circuits. It makes use of the fact that a typical voice circuit is active about 40 percent of the time during a conversation. The basic principle is to monitor activity and assign only the active channels for transmission. Competition for available channels may lead to clipping. The effective gain in capacity is presently about two. By utilizing predictive algorithms, system gain will increase to three of four. It is anticipated that TASI will impact the cost of switched voice circuits rather than dedicated circuits.

F.3.3.4 Fiber Optic Devices

The predominant form of fibers utilized today for fiber optic cables is the multimode, graded index fibers. The loss characteristics of this fiber was shown in Figure F-17. The theoretical limit in bandwidth of this type of fiber is about 10 GHz per Km, although the practical limit is in the range of 1 to 2 GHz.

The predominant wavelength of today's installed fiber optic systems is 850 nm. The loss at this wavelength is in 2.5 to 3 dB/Km range. To achieve the system gain necessary for a system with reasonable margin, it is necessary to use laser transmitters and avalanche photo detector receivers.

The window of 1300 nm loss approaching 0.6 dB/Km is very attractive and will have considerable application. Increased span length can be obtained at the 1300 nm wavelength. It is possible to increase the capacity of a fiber by the use of wavelength multiplexing.

F.3.3.5 Future Costs

F.3.3.5.1 Digital Radio Systems

It was discussed in a section above, that future radio will expand in the channel capacity. This trend will have a substantial impact on the cost per channel basis. It is anticipated that the reduction factor are: 1, 0.75, and 0.64 in 1982, 1990 and 2000, respectively.

Table F-57 shows the annualized costs per channel using the above factors.

F.3.3.5.2 Fiber Optic Systems

Large capacity optical fiber systems started to be used and the main body of the intra and inter-city trunking. The reduction in cost of cable and optical equipment will be 15 percent per year until the year 2000. However, installation of the cable and duct lease and right of way form a major phase of the cost of the system. For this reason, the annual cost per channel will be reduced by 30 percent in 1990 and 40 percent in 2000. Table F-58 shows the annualized costs per channel.

F.4 CPS END-TO-END USER COST AND CROSSOVER DISTANCES WITH TERRESTRIAL TARIFFS (1982)

The common cost components of a CPS network are:

a. Space segment cost
b. Earth segment cost
c. Terrestrial segment cost
d. Central network control facility.

The approach used to derive end-to-end user costs is to allocate the common element costs to the services under consideration and add that to the channel dependent costs. The end-to-end costs will be derived for two cases:

a. The CPS earth station located on the customer's premises. The earth stations considered have the availability of .995 and .999.

b. The shared CPS earth stations with dedicated tails to the customers. The earth staions are designed with .995 and .999 availability. Only large and medium earth stations are shared. the terrestrial tail exensions are the dedicated facilities leased from common carriers. Thus, in costing the terrestrial tariffs are used for extensions.

The end-to-end user costs are then compared with terrestrial tariffs to estimate the distances for various services.

F.4.1 CPS End-to-End User Costs

For estimating the end-to-end user costs for various CPS earth station types, (refer to Paragraph 1), the following assumptions are made.

a. Costing is done on the basis of two nodes.

b. The earth station at each node is the same type.

c. The interface to customer equipment is for voice and data and teleconferencing.

d. The annual payoff requirement is calculated based on a ten year depreciation. The annualizing factor of 41 percent is used.

e. The space segment annual payoff requirement is calculated using the size of CPS earth stations as defined in Section 1 and the annual payoff requirement for transponders as calculated in Section 2.

f. The annual payoff requirement for network control centers per CPS earth station for 1982 is about $6K.

g. For computing crossover distances, the following terrestrial tariffs are considered:

FCC NO260 for Voice

FCC NO267 for Data with speeds ranging from 2.4 KBPS to 1.544 MBPS.

F.4.1.1 C-band CPS End-to-End User Costs and Crossover Distances With Terrestrial Tariffs

Table F-59 summarizes the C-band annual recurring cost of the common systems in thousands of dollars. Table F-60 summarizes the end-to-end user costs with earth stations on the customer's premises, whereas Table F-61 sumarizes the end-to-end user costs with dedicated tail circuits of 3 miles for shared earth stations. Only large and medium earth stations are assumed to be shared. For end-to-end user costs common systems costs are allocated on the basis of capacity requirement of the user service. Channel dependent costs for services are then added to the common systems cost of the service. Tables F-62 and F-63 present the crossover distances for unshared CPS and shared CPS respectively.

F.4.1.2 Ku-band CPS End-to-End User Costs and Crossover Distances With Terrestrial Tariffs

The common system annual revenue requirment for Ku-band is summarized in Table F-64. Tables F-65 and F-66 present the end-to-end user costs for unshared earth stations and shared CPS earth stations, respectively. Tables F-67 and F-68 present the crossover distances for unshared and shared earth stations.

F.5 FUTURE TRENDS

F.5.1 Digital Trend

It is generally accepted that the communication trend is towards total digital systems, as opposed to analog sytems, therefore it will be assumed that in 1990 and 2000, the communication will be entirely digital. The reason behind this trend is twofold:

a. Availability of digital microcircuitry at reasonable prices, which makes digital processing cost effective (see references).
b. The requirements for integrated services.

F.5.2 Capacity Improvement Techniques

Presently in digital transmission schemes, the TDM/TDMA approach with quadrature phase shift keying (QPKS) is being used. With this approach a typical C-band 36 MHz wide transponder could transmit 60 Mbps of information. It is anticipated that by the year 1990 more spectrally efficient modulation schemes will be used. It is assumed that in 1990 the transmit capacity of a typical C-band transponder will increase by 500% to 90 MBPS.

Presently for digital transmissions of voice, 64 KBPS pulse code modulation (PCM) is used. In the year 1990 it is assumed that voice will be transmitted at 32 KBPS, thus the number of voice channels per transponder could increase by 2. Voice activity compression could also be used for voice circuits which would further increase the voice handling capacity by 2. Thus the voice channel capacity per transponder could quadruple with 32 KBPS coding and implementation of voice activity compression.

It is anticipated that the preferred approach in the future will be the TDM/TDMA, be it in earth station or space segment. For microprocessor-based hardware, the price has been falling at an average rate of 7% a year for nearly 20 years, in spite of inflation. That trend shows no sign of bottoming out, as more uses are found for the very large scale integrated circuits (VLSI). Since TDM/TDMA design can be based on microprocessors (some manufacturers have already designed TDM/TDMA equipment based on microprocessors) in conjunction with software (for routing, formatting, framing, synchronization, encoding, forward ever connection), it is anticipated that cost of the TDM/TDMA terminals will also reduce at a rate of 15% (in 82 dollars) until 1990 and 10% until the year 2000. Cost projections of TDMA terminals are given below:

COST OF TDMA TERMINALS IN THOUSANDS OF DOLLARS IN 1982

Year	Burst Rate	60 MBPS	15 MBPS	8 MBPS
1982	Non-redundant	140	50	40
	Redundant	240	80	58

1990	Non-redundant	34.1	13.82	11.00
	Redundant	55	21.8	16.00
2000	Non-redundant	12	5.00	3.8
	Redundant	19.2	7.60	5.6

Presently it is seen that the price of common equipment allocated to a particular service is quite negligible as compared to channel derivation cost. For example, for a large CPS earth station, the common equipment price for 2.4 KBPS end to end channel with C-band transponder is only $179/year whereas the annual recurring price for 2.4 KBPS channel units at both ends is $4,000/year. For rates up to 56 KBPS the channel unit price contributes heavily to end to end service costs. It is anticipated that plug in channel units will also be microprocessor based and costs will come down at the same rate as TDMA equipment.

COST OF CHANNEL UNITS IN THOUSANDS OF DOLLARS

Year	Voice	2.4 KBPS	4.8 KBPS	9.6 KBPS	56 KBPS	1.5 MBPS	6.3 MBPS
1982	0.7	3.5	3.5	3.5	3.5	6	9
1990	0.2	1.0	1.0	1.0	1.0	1.6	2.5
2000	0.07	0.3	0.3	0.3	0.3	0.56	0.84

F.5.3 Radio Frequency (R F) Components

Major earth station R F components include low noise amplifiers (LNAs), high power amplifiers (HPAs), and antennas. The following sections will discuss technology advancements in these areas.

F.5.3.1 Low Noise Amplifiers (LNA)

The LNA for satellite communications are of two types: the paraamp LNA and FET LNA. The cryogenically-cooled paraamp LNA was extensively used in the infancy of satellite communications but due to maintenance difficulties and high cost it is hardly used today. The thermoelectrically-cooled and uncooled paraamp LNAs are used in large earth stations. Those LNAs feature almost as

low noise temperature as do the cryogenically-cooled paraamp LNAs, due to improvements in the Varactor and increased pump efficiencies.

The FET LNA is employed mainly for DOMSAT and especially for TVRO systems. Thermoelectrically-cooled and uncooled versions are used almost universally for those applications. For C-band typical noise temperature curves of 35° K T E cooled 45° K T E cooled, 55° K uncooled paraamp LNAs , T E cooled 80° K FET LNA and uncooled 100° K FET LNA are shown in Figure F-21.

FET LNA is maintenance free and is more reliable than the paraamp LNA.

The C-band LNA has made excellent technological progress in the past, and it is expected that by year 1990 it will be possible to realize noise temperature below 30°K for paraamp LNA and 70°K for the FET LNA. The LNAs will get smaller and smaller and eventually LNA will take up only a small part of antenna installation. It is expected that LNA will eventually be reduced to about half its present size.

Ku-band (14/12 GHz) has come to be utilized as a second generation satellite communications band. In fact, Satellite Business Systems (SBS) has already launched three Ku-band satellites and will be launching a fourth satellite later this year. The two types of LNAs discussed above are used in Ku-band also. The major problem with 12 GHz LNAs is the increase in noise temperature contributions by connecting components such as wave guide switches and lines. At this frequency the overall design configurations become extremely important.

Typical noise temperatures for TE-cooled paraamp, LNA, uncooled paraamp LNA, TE-cooled FET and uncoooled FET are shown in Figure F-22.

It is expected that the noise temperature performance of TE-cooled FET LNA will approach that of the uncooled paraamp LNA in the future. Due to this only TE-cooled paraamp LNA is expected to find application. A minimum noise temperature of 80° is expected for TE-cooled paraamp LNA, while TE-cooled FET LNA will attain noise temperatures of less than 130°K as opposed to its present 150°K.

F.5.3.2 Power Amplifiers

The technological evolution in the area of power amplifiers has not kept pace with the rapid technological advances of LNA, but the advent of power FET has provided another alternative to traveling wave tubes (TWT) and IMPAT amplifiers for earth stations and satellite transponder application for power levels up to 10 watts at C-band. In space application (for communication payloads) the trend is towards higher powered transponders, which make earth stations smaller.

For earth terminals, both klystrons and TWT's serve the uplink with power levels of up to 10 K watts at 8.2 GHz, 2 K watts at 14.5 GHz and 800 watts at 30 GHz available from manufacturers in Japan and Europe. The TWT and klystron HPAs are nonlinear devices. The effect of nonlinearity is that the output signal not only contains the fundamental frequency but also harmonics which introduce distortion in the signal. Another effect is the intermodulation products for multi-carrier operation of the transponder. Because of these effects, the HPA is normally operated in backed off mode in linear region, which reduces the available power and hence the capacity. A lot of research is going on in the area of linearizing HPAs. It is anticipated that in future substantial linearization will be achieved. With linearization of HPA one can either increase the transponder capacity or reduce the size of the tube.

For space applications, TWTs have been the mainstay of communication transponders from the beginning of satellite communications. Current TWTs provide efficiencies up to 40% and have an operational life of 7 years or more. There has been considerable effort to develop solid state counterparts for TWT power amplifiers. Impact diodes have an edge at frequencies above 20 Ghz; the real impact at bands of immediate frequencies is being made by GAS FET amplifiers. GAS FET amplifiers are expected to provide comparable efficiencies, better IM products, smaller volume and of course, simpler power supplies. It is expected that at C and Ku-bands GAS FET amplifiers will be used, reducing satellite size and weight requirements and increasing operational life. For frequencies over 20 Ghz Impatt amplifiers are expected to be used. As yet there are no plans beyond utilization of Ka-band (20/30 Ghz) communications satellites. Gyrotron

amplifiers may eventually make it possible to handle telecommunication requirements at 35 Ghz and beyond. It is reported in the literature that development of such tubes is proceeding with encouraging results.

F.5.3.3 Antennas

The antennas for initial communications satellites were area coverage type i.e., a single beam covering the whole or a major part of the visible portion of the earth and radiating all the available frequencies only once. They were a very small fraction (1%) of total end of life (EOL) mass of the satellite. Antennas have become more complicated through the years and weigh about 9% of the spacecraft mass and 30% of the total communication subsystem mass. Technological trends in the design of COMSAT antennas are:

a. Multiple frequency bands
b. Greater bandwidths
c. Multiple beam antennas
d. Higher EIRPS (i.e., higher efficiencies and larger apertures)
e. More feed elements
f. Improved spacecraft pointing accuracies
g. Greater antenna subsystem mass
h. Deployable antennas
i. Reconfigurable and steerable antennas
j. Improved sidelobe performance
k. Improved polarization performance
l. Extreme thermal environment.

As the trend towards complicated antennas grows, the material technology is becoming an increasingly important aspect of antenna design. Demand for lightweight thermally stable materials such as graphite film reinforced plastic GFRP (RF reflective) and Kevlar epoxy (RF transparent) will grow as surface accuracy and temperature environments become more stringent. This will reduce the weight of antenna subsystems. It should be noted that spacecraft antenna performance will play an important role in realizing higher communications capabilities in satellites. Research and development efforts are continuing

in the area of innovative feed systems, beams forming networks and reflector, lens, or array aperture configurations.

F.5.4 Transponder Trends

When the initial communications satellite was launched, its basic function was frequency conversion and signal amplification. There was one beam per transponder. A frequency band was used only once. This transponder configuration is shown in Figure F-23.

The next step was to use dual polarization schemes and frequency reuse factor was increased by 2. The DOMSATS had 24 transponders, the two transponders using the same frequency with dual polarization. The configuration of this transponder is shown in Table F-69.

The connection between transponders is achieved through the earth stations primarily by frequency hopping techniques. All the domestic communication satellites in C-band are of this type. Case II shows a multibeam transponder. The transponders are connected by a radio frequency (RF) switch matrix or IF switch matrix (GE and Ford Aerospace are developing these IF switch matrices for Ka-band satellites under contract for NASA). Advanced WESTAR, to be launched in the near future, will use 4 x 4 switch matrix for Ku-band transponder. The EIRP and G/T are improved by the incrased gain of multibeam antenna. The increased capacity is then transmitted via satellite transponders. The interconnection between various beams may be obtained by means of a FDM-FDMA approach or SS-TDMA approach. Due to advances in digital technology, SS-TDMA seems to be a more viable technology.

Case III shows a transponder using on-board regeneration technology. Signal processing is performed digitally on-board the satellite. The effects of regeneration are:

a. Decoupling of uplinks and downlinks
b. Improvement of signal quality due to signal processing, such as error correction decoding and encoding

c. Use of TDM signal for the downlink simplifies the earth station configuration.

Case IV is a combination of Case II and Case III. It uses multibeam transponders with on-board regenerative technology. Beam switching is performed in time division baseband processor.

Case V shows the transponder configuration performing signal speed conversions along with regeneration. The advantage of this approach is flexibility in earth station design. In addition, earth station design can be customized to a subscriber's need.

Case VI shows the ultimate satellite design which employs an IF switch for multibeam connectivity for high speed (bit rate) beams. This will be used for high speed trunking applications. It also employs a regenerative technology for low speed customer premises services. This is the type of transponder approach being proposed for Ka-band satellites. It also provides connectivity between trunking and CPS users. It is expected that by 1990 the technology will support the launch of such a communications payload. In addition to the evolution in transponder technology there is a trend towards ever larger satellites with multiple mission capabilities and multiple users and ownership. This concept is that of space platforms. These structures are expected to have a capability of progressive addition and/or replacement of parts of the payloads. The size and weight of a space platform will be a function of the capabilities of available launch vehicles. Figure F-24 summarizes the increase in launch vehicle capability.

F.5.5 Technology Impacts on Cost

It is expected that costs of RF portion of earth stations will come down by 3 percent a year because of expected technological advances forecast for the future. M&C subsystem being based on microprocessors in conjunction with software will also reduce by the same factors as TDMA.

F.5.5.1 Impact of Technology on Transponder Prices

In the previous section technology trends and advances were discussed in the areas which could impact the satellite costs.

F.5.5.2 C-band

C-band satellite have been used for about a decade for domestic communications in the U.S. and Canada, and it is felt that costs of C-band satellites will stay at the same level as they are today. The reasons are:

a. C-band satellite spacing will probably be as high or higher as compared to Ku- and Ka-band.
b. C-band is the most suitable frequency spectrum for communications from the point of view of propagation characteristics and availability.
c. Most suitable for broadcast applications
d. Technology is quite mature at C-band.

Even though transponder prices will stay constant, the amount of information which could be carried by a standard 36 Mhz C-band transponder will increase to 90 MBPS by 1990.

F.5.5.3 Ku-band

Presently a Ku-band transponder annual payoff requirement is almost twice that of a C-band transponder. As Ku-band technology matures and more and more Ku-band satellites are launched, it is felt that the Ku-band transponder prices will decrease and finally level off at the same value as C-band. With this assumption the price will fall at 3.5 percent per year. The factors by which prices will decrease in 1990 and 2000 are given below.

	1982	1990	2000
Transponder lease price	1	0.75	0.53

In addition to the price reduction, the transponder will transmit 90 Mbps instead of 60 Mbps by year 1990, as the bandwidth of Ku-band transponder is higher. By 2000 it is felt that due to more efficient modulation techniques a Ku-band transponder will transmit 135 Mbps.

F.5.5.4 Ka-band Satellite

Ka-band systems are still in the planning and development stages and it is not known with any amount of reasonable certainty as to when a Ka-band system will be implemented. The costs used for 1990 were those given by NASA. What the costs will be in 2000 depends on many factors, among them:

a. The first implementation of Ka-band systems and acceptance of their performance by the user community
b. The technological advancements in Ka-band, depending on the need and the vigor with which development is pursued.

Because of the uncertainty and inability to look into the future for some system which does not exist as yet, it is assumed that the satellite costs will remain the same.

F.5.5.5 Reduction Factors

Reduction factors are given in Table F-70. With these reduction factors, costs of earth stations in years 1990 and 2000 are summarized in Tables F-71 and F-72.

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F.6 1990 AND 2000 CPS COSTS AND CROSSOVER DISTANCES WITH TERRESTRIAL TARIFFS

The methodology used for deriving the CPS Service costs, annual payoff requirements, etc., is the same as used in Section 4. The CPS earth station costs

for C, Ku and Ka-band were projected to years 1990 and 2000 in Section5. For Ka-band systems, the CPS earth station costs were projected to remain the same as the costing already takes into account for the quantity production, streamlining of manufacturing processes and technological advances. It is also anticipated that the equivalent transponder price will drop to 2.0 M per year due to the trend towards large spacecrafts for Ka-band.

The cost components for a CPS Network are the same as described in Section 4. In Section 5, the costs of earth stations, space segment, network control facility, etc., were projected for the years 1990 and 2000 for C, Ku and Ka-band. For C-band space segments, it was estimated that the transponder price will increase due to efficient modulation techniques. The cost of Ku-band transponders was projected to reduce and level off to a C-band transponder by the year 2000. The bandwidth efficient modulation techniques help to increase the capacity only if it is a single carrier, full transponder earth station. For a multiple carrier system, usually, the system design is power limited and/or interference limited, hence, bandwidth efficient techniques cannot be used.

F.6.1 1990 and 2000 Common System Costs

Using the network assumptions of Section 4 and cost projections made in Section 5, the common system costs are estimated for large, medium, small and mini earth stations with .995 and .999 availability. Tables F-73 and F-74 present the C-band common system annual payoff for the years 1990 and 2000. Table F-75 and F-76 present the Ku-band common system annual payoff for the years 1990 and 2000. Table F-77 and F-78 present the common systems annual payoff for Ka-band for the years 1990 and 2000.

F.6.2 Terrestrial Tariffs

In Section 4, 1982 satellited based end-to-end user costs were compared to terrestrial tariffs. For obtaining an estimate of crossover distances for various services, the terrestrial tariffs are projected to the years 1990 and 2000. In projecting the terrestrial tariffs, the following factors are taken into account:

a. Past history of terrestrial tariffs

b. Technological advancements

c. Diversity of Bell Operating Companies (BOC) from AT&T Long Lines.

Historical data reveals that prices of communications services have increased much less rapidly than all consumer spending over the last 12 years. This is due to the competitive pressure exerted by the entry of specialized common carriers since 1970, and rapid advancement in digital technology and integrated circuitry.

The impact of the diversity of BOCs from AT&T's Long Lines on the tariffs is hard to estimate, but it is a generally accepted fact in the communications industry that Long Line Tariffs should come down and local tariffs will go much higher.

For this study, it is assumed that in the period 1982 to 1990, the central office-to-central offices (long haul) tariffs will be reduced by 12 percent, where the termination charges will reduce by 20 percent. For the period 1990 to 2000, the long haul tariffs will be reduced by 7 percent, whereas the termination charges will be reduced by 15 percent. The reduction factors used for terrestrial tariffs are given below:

REDUCTION FACTOR

	1982	1990	2000
Long Haul Tariff	1	.88	.82
Digital Termination	1	.8	.68

It is assumed that the tariff structure will remain the same in 1990 and 2000, as it is now in the year 1982.

F.6.3 1990 and 2000 Crossover Distances for CPS Earth Stations

F.6.3.1 C-band

Using the Tables F-73 and F-74, the end-to-end user coss for various services are derived. The common system cost is allocated to each service in proportion

to the capacity requirement. To this cost is added the annual payoff for the channel units. The costs of channel units for 1990 and 2000 were estimated in Section 5. The monthly payoff requirement for each service types are presented in Tables F-79 and F-80 for the years 1990 and 2000 for unshared CPS Systems, while Tables F-81 and F-82 present the monthly payoff requirement for each service type for the years 1990 and 2000 for shared CPS earth stations. The monthly payoff requirements are compared with terrestrial tariffs and crossover distances computed. The crossover distances for unshared earth stations are presented in Tables F-83 and F-84 for years 1990 and 2000, while Tables F-85 and F-86 present the crossover distances for shared CPS earth stations for the years 1990 and 2000.

F.6.3.2 Ku-band

The monthly payoff requirements and crossover distances for unshared and shared earth stations are presented in Tables F-87, F-88, F-89 and F-90 for the years 1990 and in Tables F-91, F-92, F-93 and F-94 for the years 2000.

F.6.3.3 Ka-band

The monthly payoff requirements and crossover distances for unshared and shared earth stations are presented in Tables F-95, F-96, F-97 and F-98 for the year 1990 and in Tables F-99, F-100, F-101 and F-102 for the year 2000.

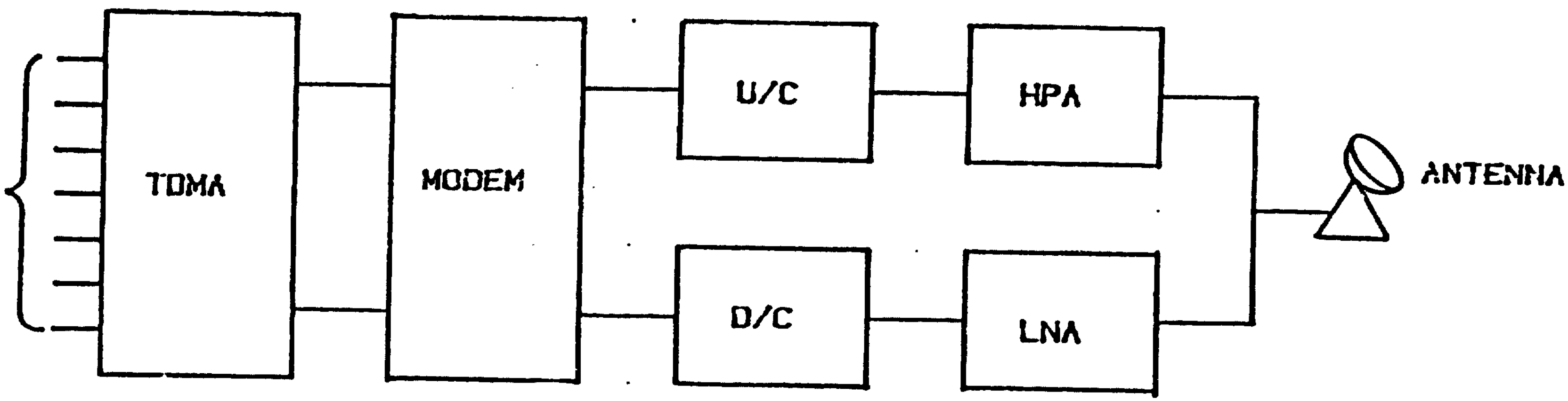


FIGURE F-1. SINGLE TREAD EARTH STATION

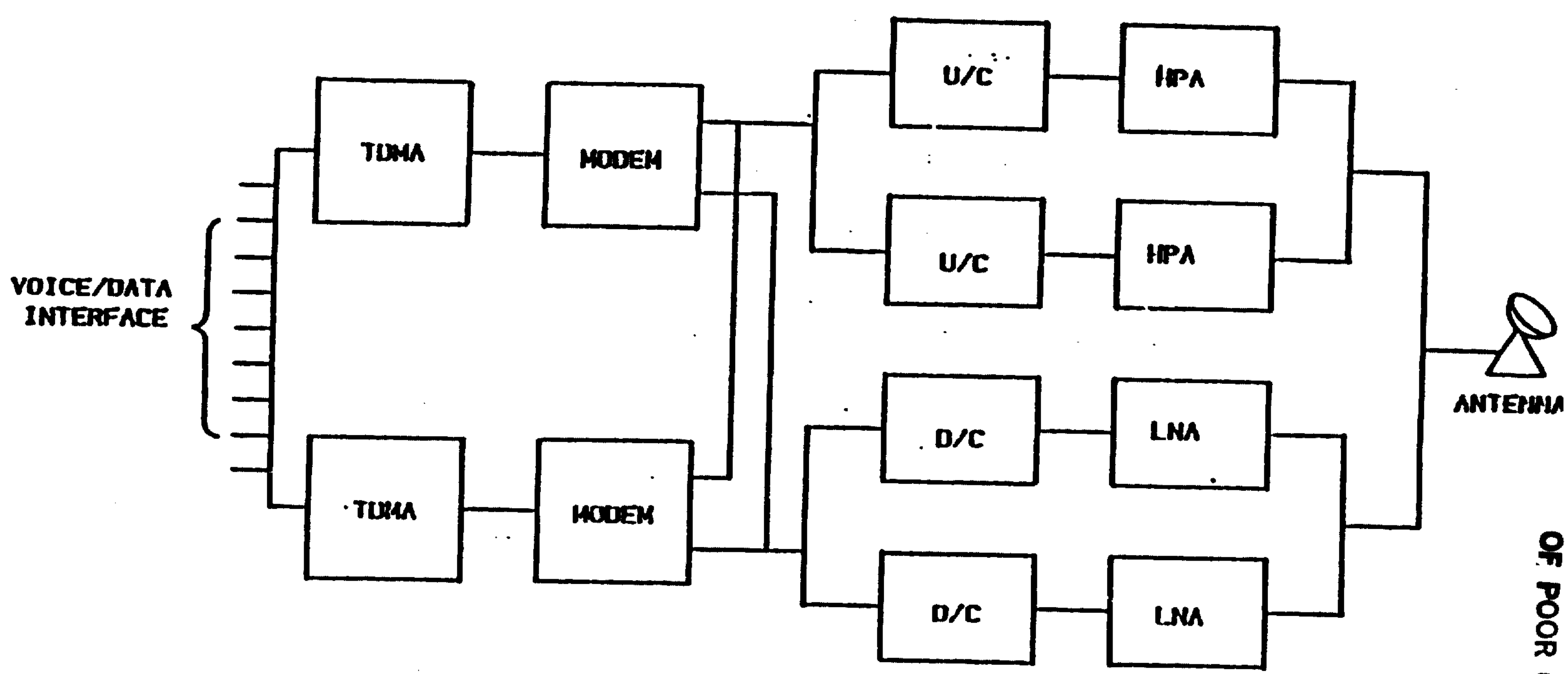


FIGURE F-2. DOUBLE TREAD EARTH STATION

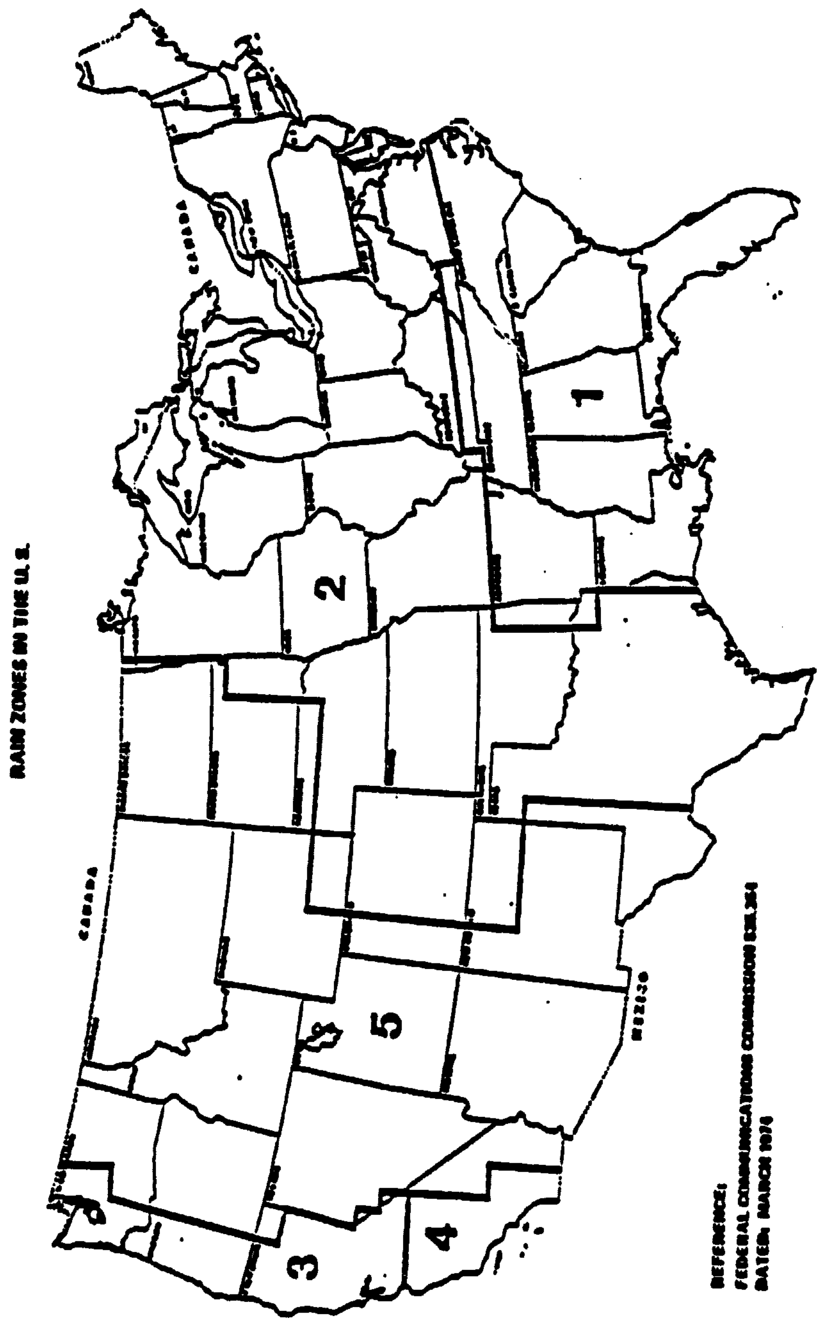


FIGURE F-3. RAIN ZONES IN THE UNITED STATES

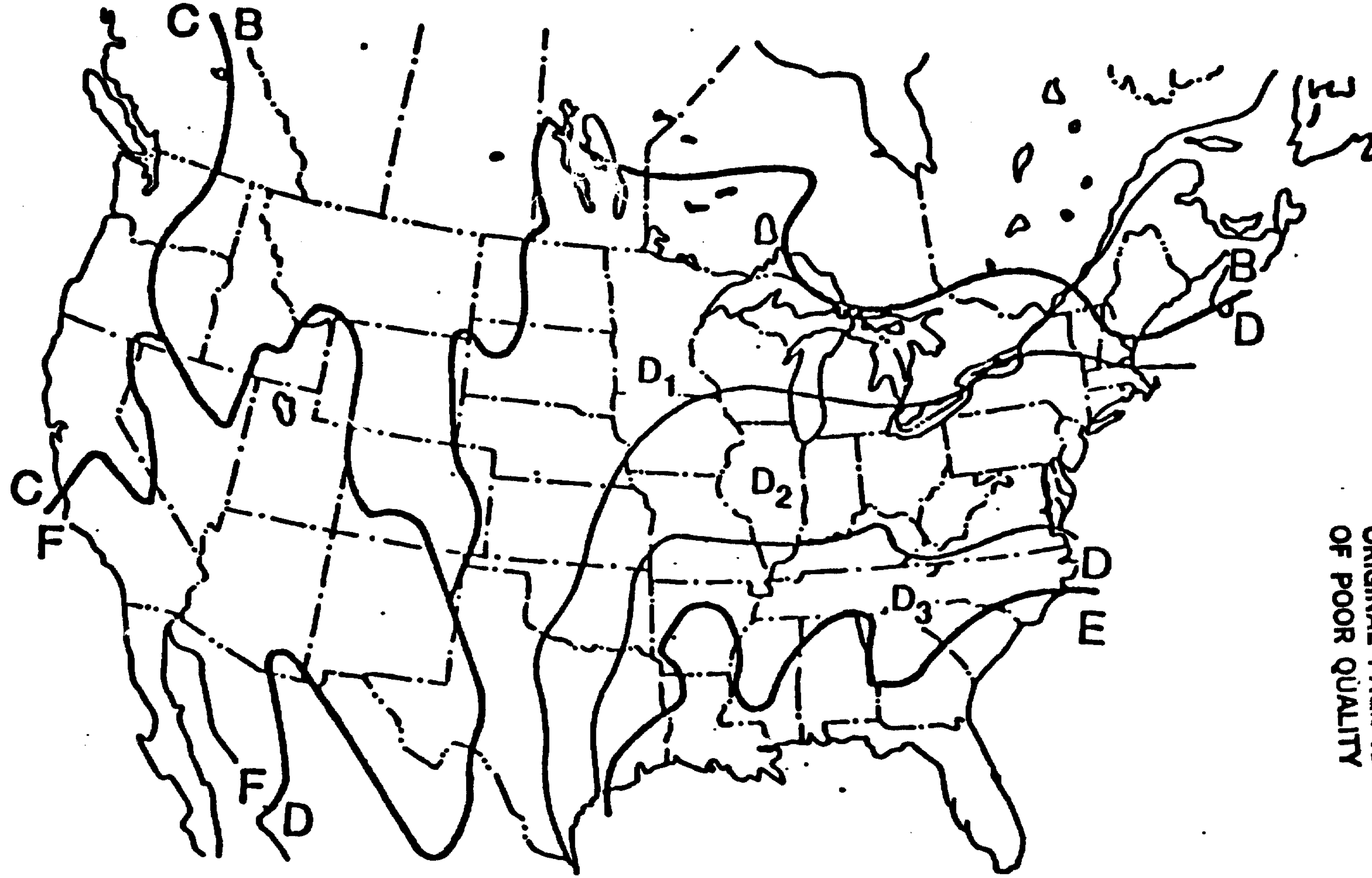
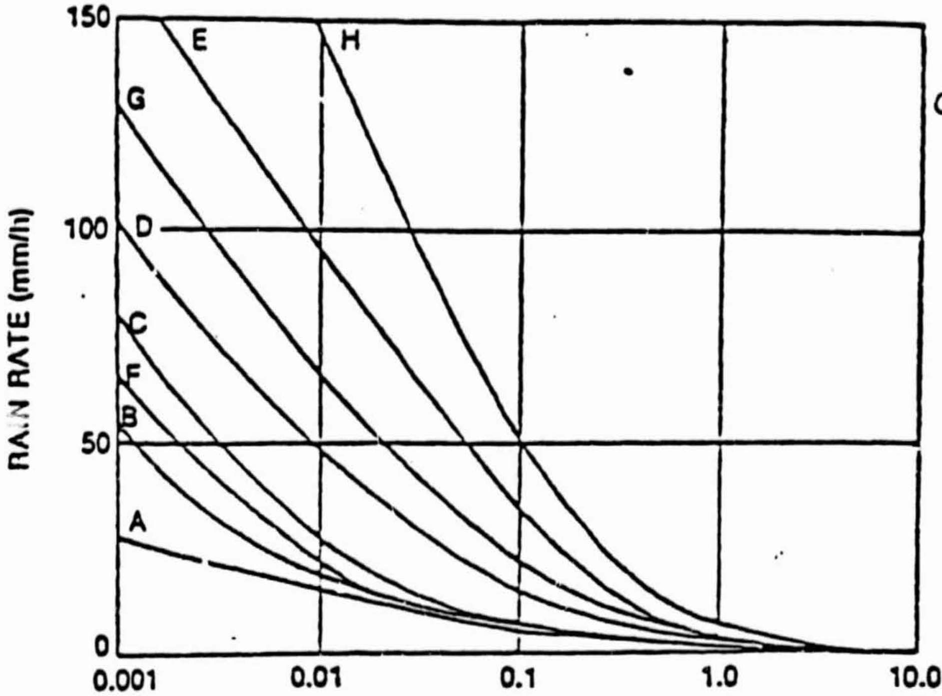
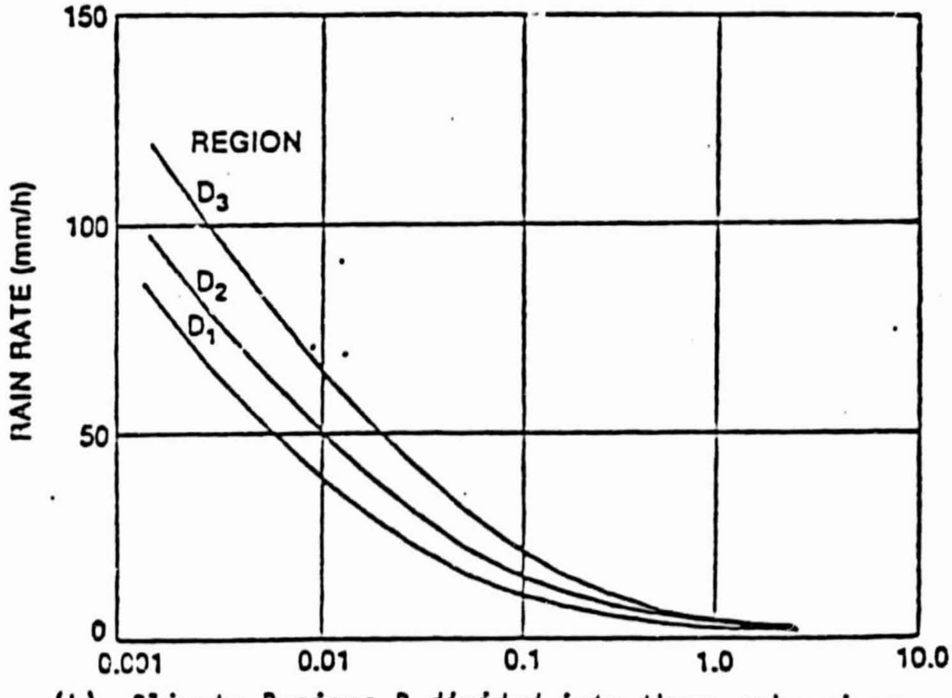


FIGURE F-4. RAIN RATE CLIMATE REGIONS FOR THE CONTINENTAL UNITED STATES SHOWING THE SUBDIVISION OF REGION D



(a) Climate Regions A to H

FIGURE F-5. PERCENT OF YEAR RAIN RATE VALUE EXCEEDED



(b) Climate Regions D divided into three subregions (D_2 = D above)

FIGURE F-6. POINT RAIN RATE DISTRIBUTIONS AS A FUNCTION OF PERCENT OF YEAR EXCEEDED

WESTAR IV - VI REPEATER BLOCK DIAGRAM

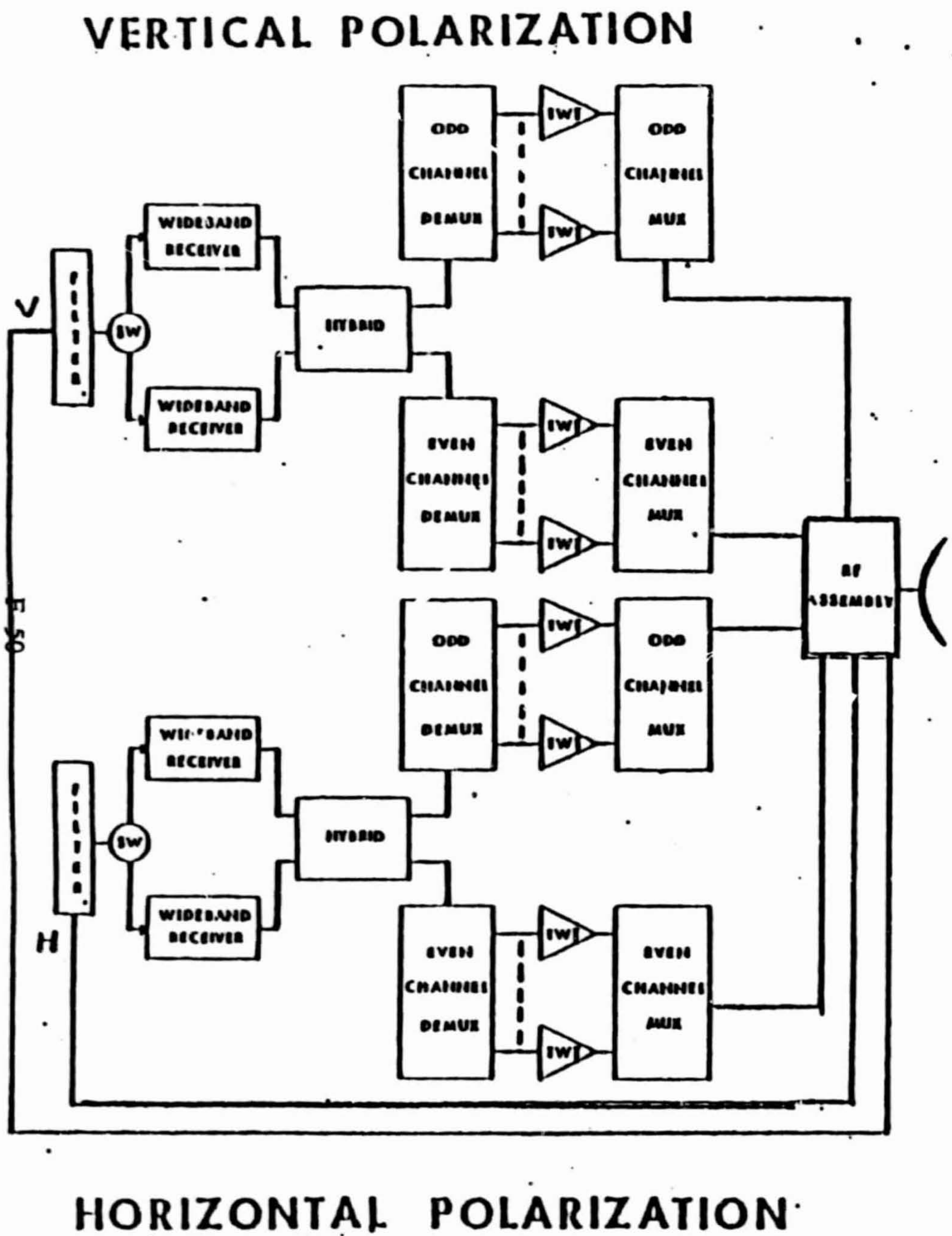


FIGURE F-7.

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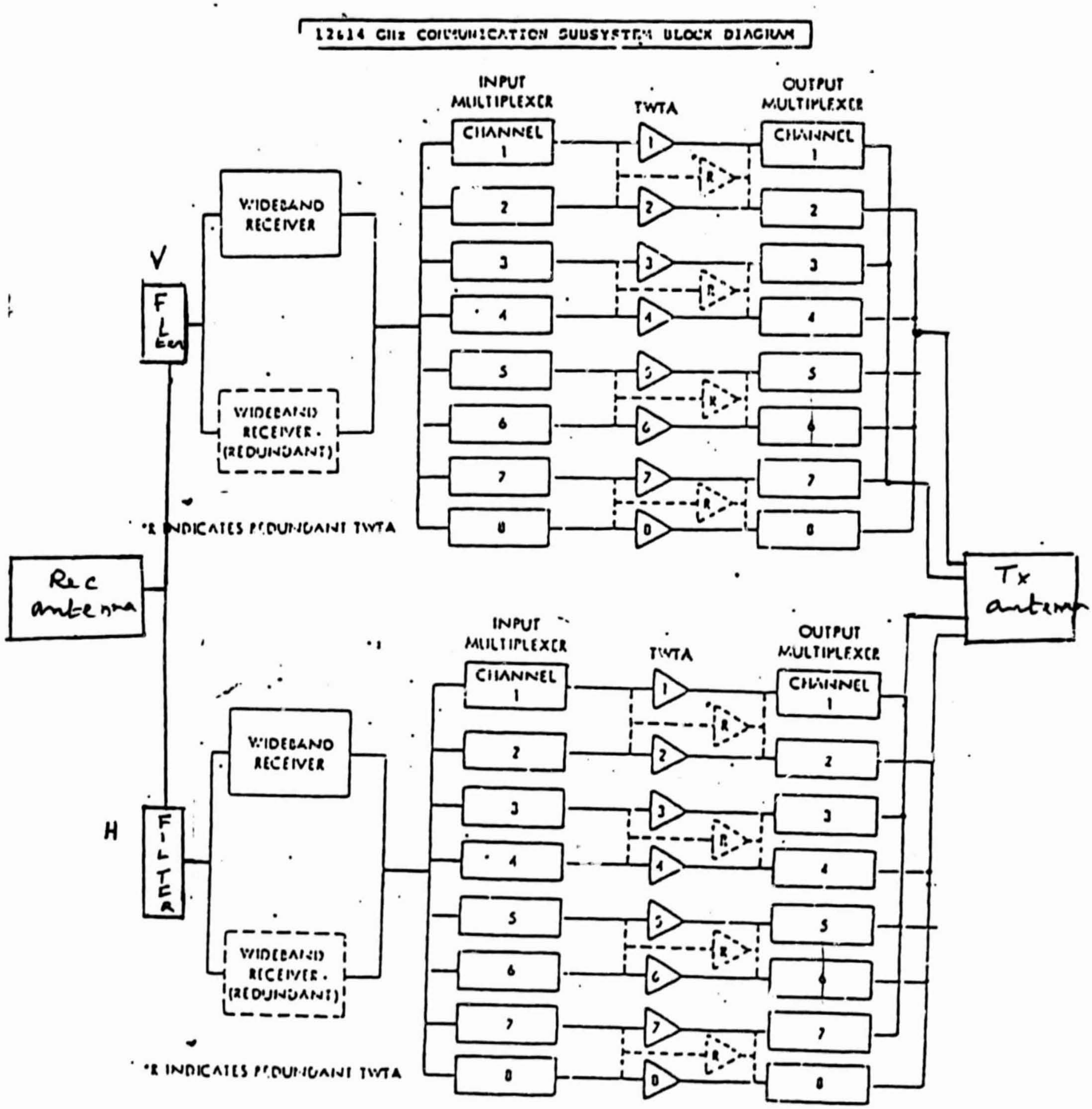

FIGURE F-8.

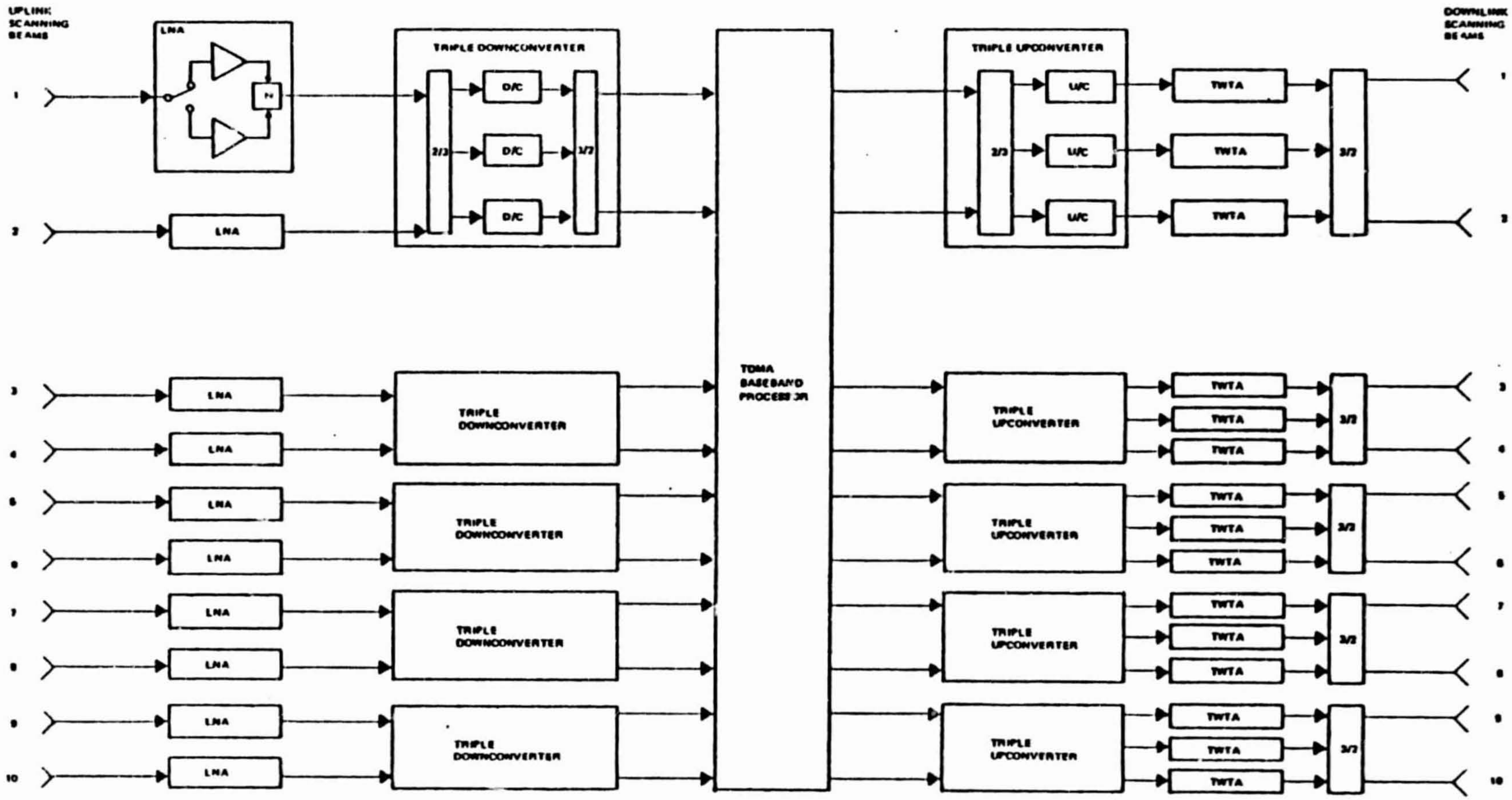

FIGURE F-9. CPS TDMA PAYLOAD
5 GBPS THROUGHPUT/10 SCANNING BEAMS

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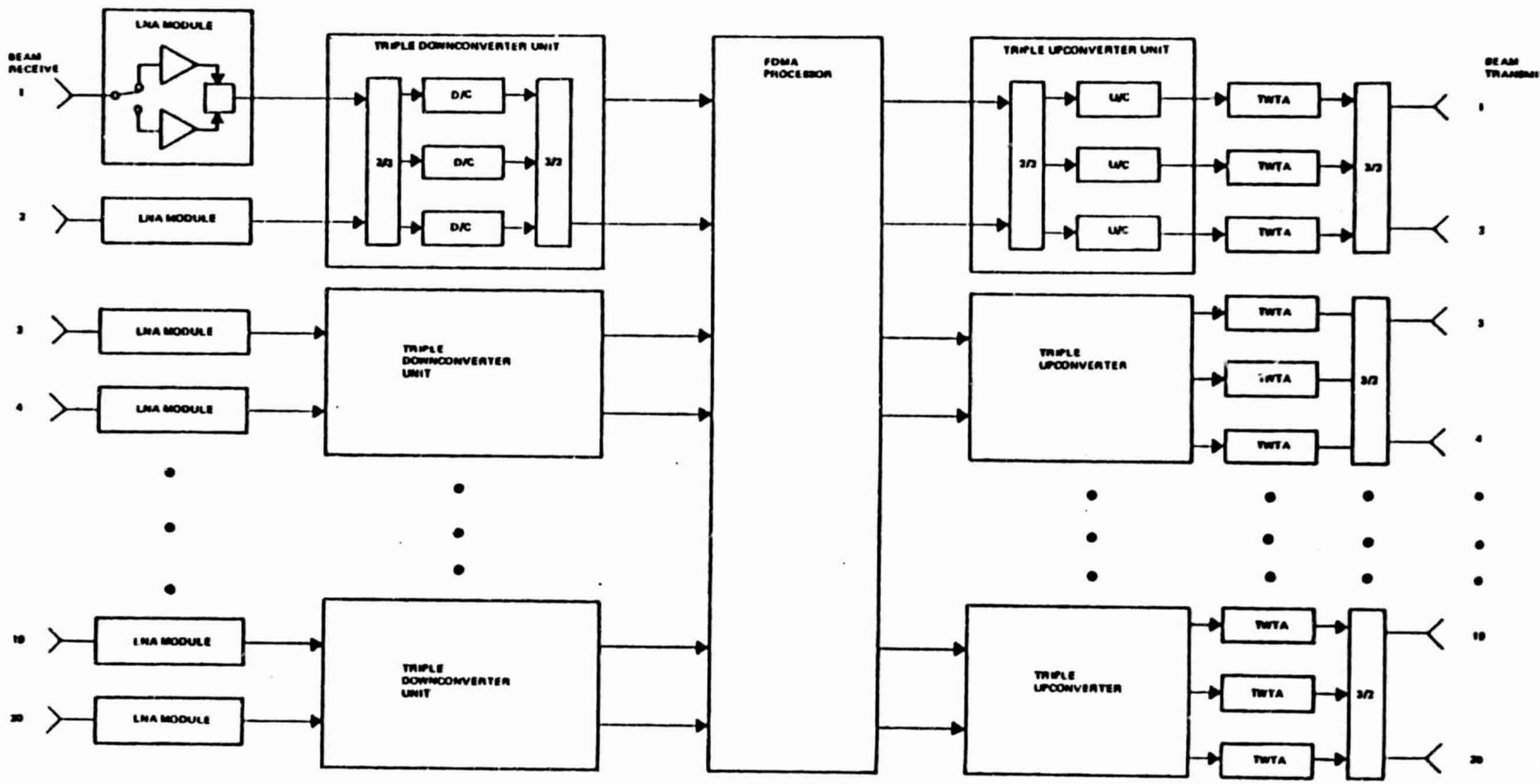

FIGURE F-10. CPS FDMA PAYLOAD
20 FIXED BEAMS, 5 GBPS THROUGHPUT

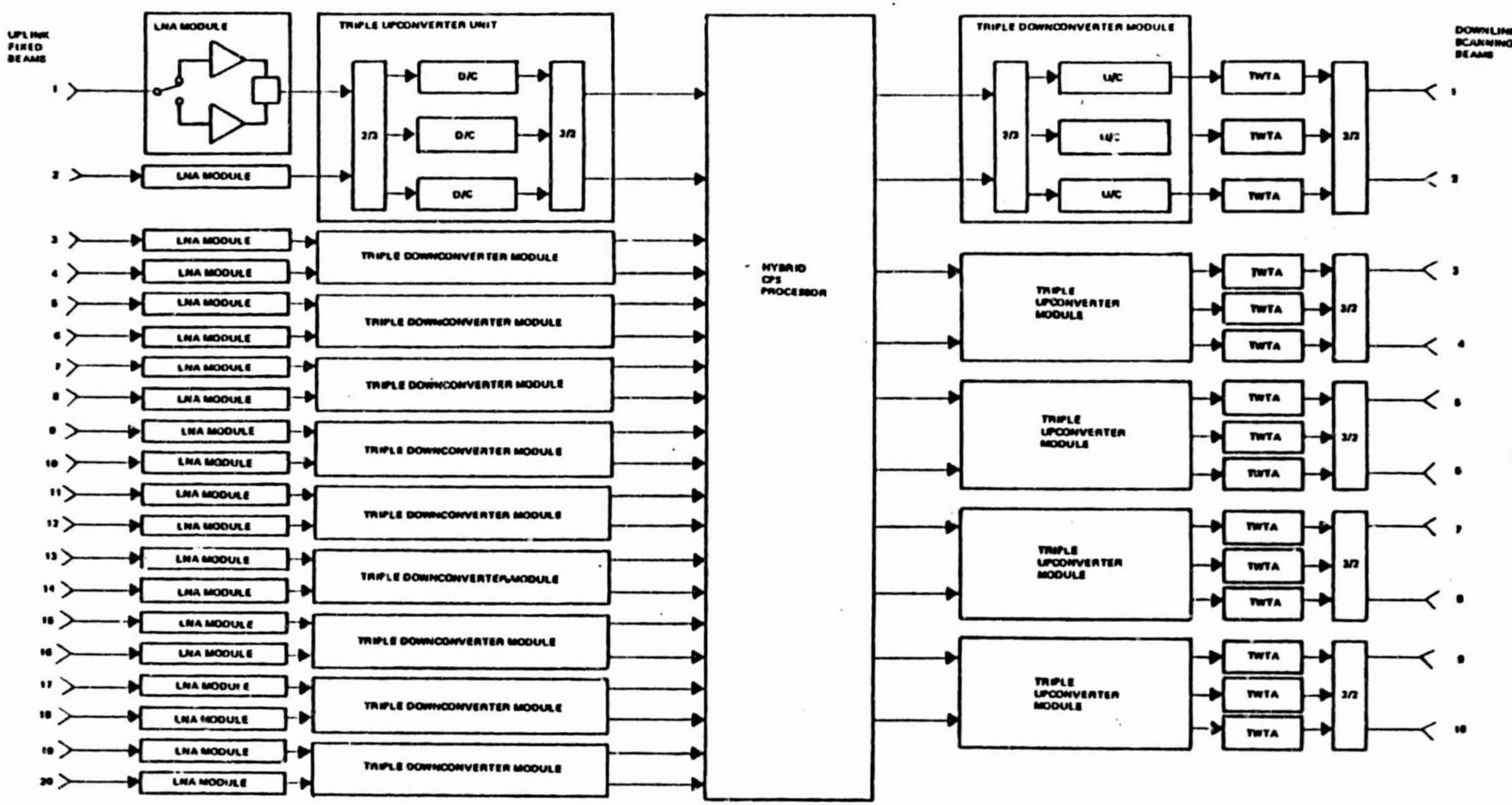

FIGURE F-11. HYBRID CPS PAYLOAD

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SPACE SEGMENT COST	N*	+ ALL LOADINGS AND PROFITS FOR N YEARS	÷ AVERAGE NUMBER OF TRANSPONDERS IN USE	= TOTAL AVERAGE PER TRANSPONDER PAY BACK	YEARLY AVERAGE PAY BACK
201 Million	8	313 M	36	14.5 M	1.81 M
1 Million/Year	10	402.2 M	36	17 M	1.7 M

N* = The life of the satellite

FIGURE F-12. C-BAND

SPACE SEGMENT COST	+	ALL LOADINGS AND PROFITS FOR N YEARS	÷	AVERAGE NUMBER OF TRANSPONDERS IN USE	=	TOTAL AVERAGE PER TRANSPONDER PAY BACK	YEARLY AVERAGE PAY BACK
248.5 M	N*	398.4		24		27.5 M	3.43 M
1 M/Year	8						
	10	511 M		24		32.1 ,	3.21 M

N* = The life of the satellite

FIGURE F-13. KU-BAND

FIGURE F-14. KA-BAND EQUIVALENT TRANSPONDER COST

TDMA APPROACH

SPACE SEGMENT COST	+	ALL LOADINGS AND PROFITS FOR N YEARS	÷	AVERAGE NUMBER OF TRANSPONDERS IN USE	=	TOTAL AVERAGE PER TRANSPONDER PAY BACK	YEARLY AVERAGE PAY BACK

Spacing	N*				
			25		
3 GBPS	8	556.1		36.3	4.54
335 M		707		42.5	4.25
2 M/Year	10				
5 GBPS	8	658.4	42	25.5	3.2
396.6 M					
2 M/Year	10	836.8		29.9	2.99
10 GBPS	8	830	84	16.0	2.00
500.0	10	1055		18.75	1.575
2 M/Year					

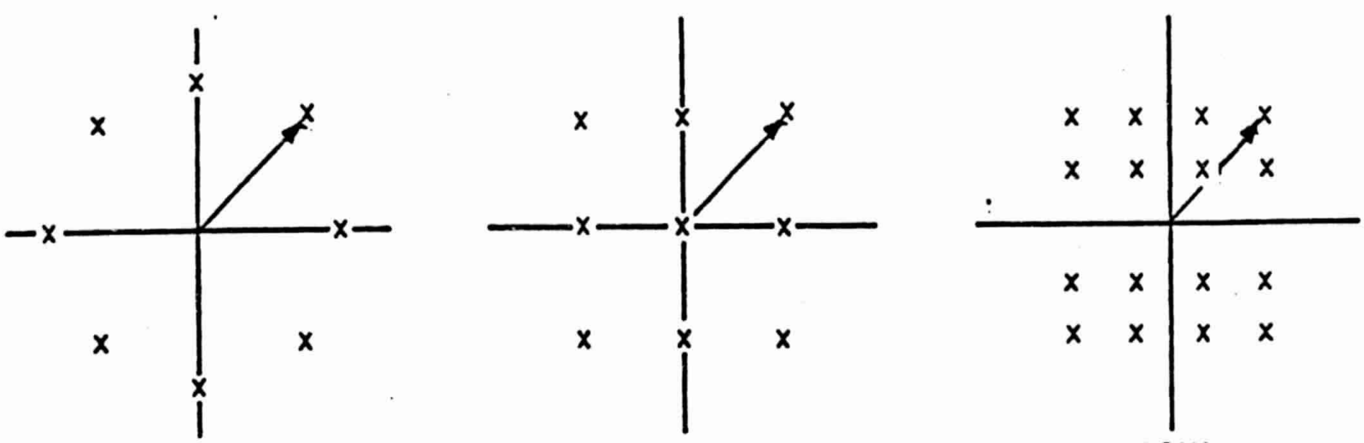

FIGURE F-15. MODULATION TECHNIQUES USED BY PRESENT DIGITAL RADIO

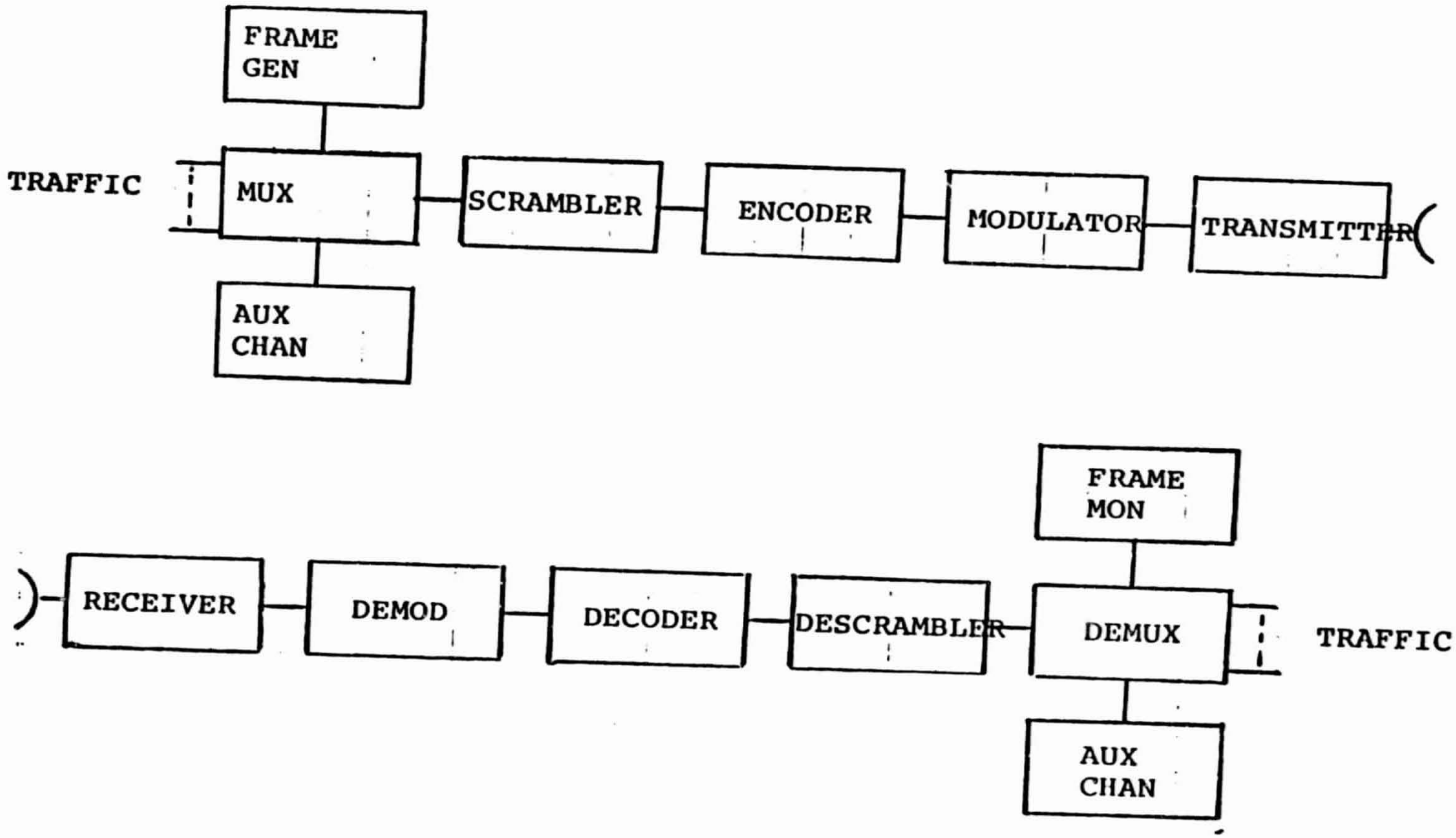

FIGURE F-16. DIGITAL RADIO BLOCK DIAGRAM

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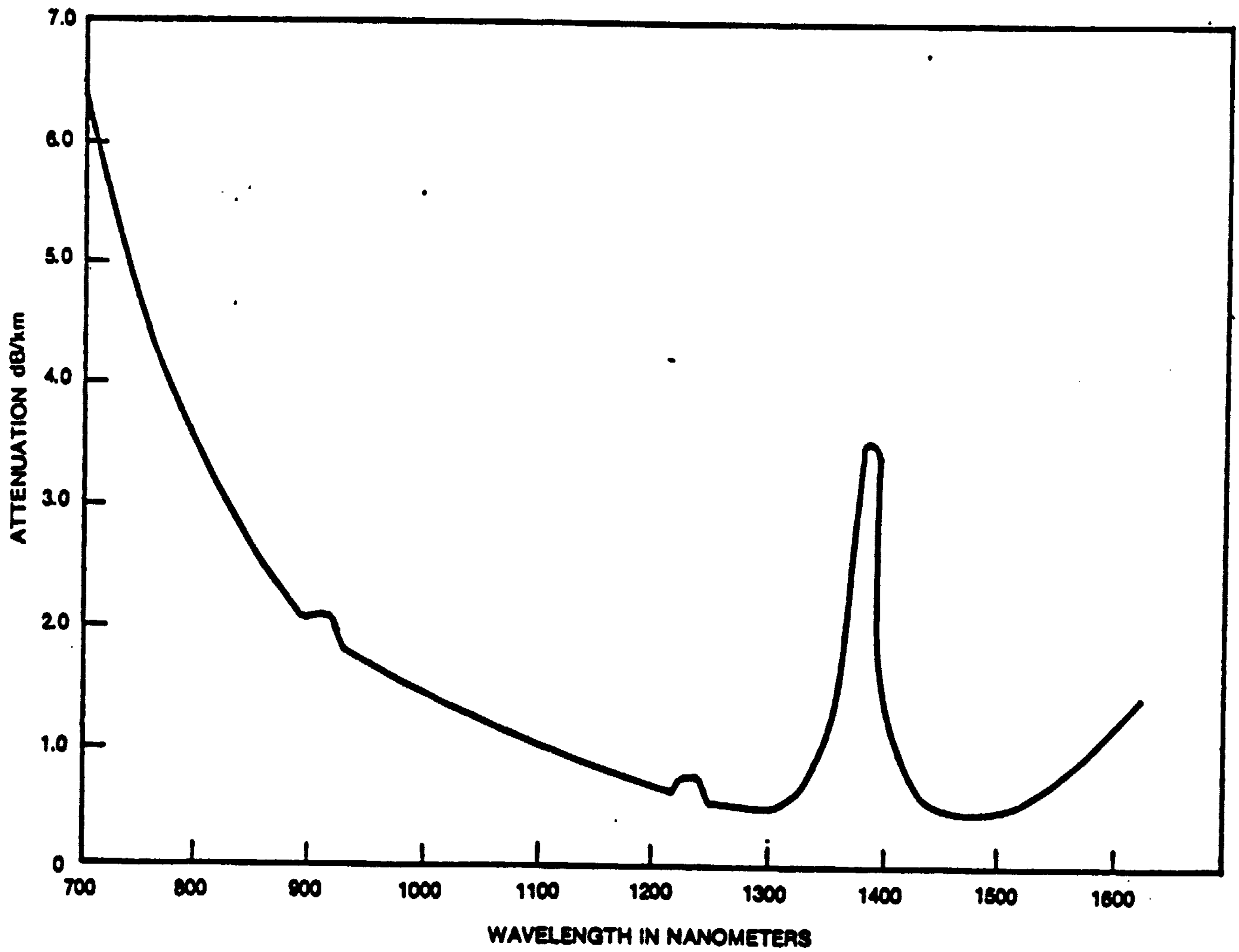

FIGURE F-17. ATTENUATION VERSUS WAVELENGTH CHARACTERISTIC OF OPTICAL FIBER

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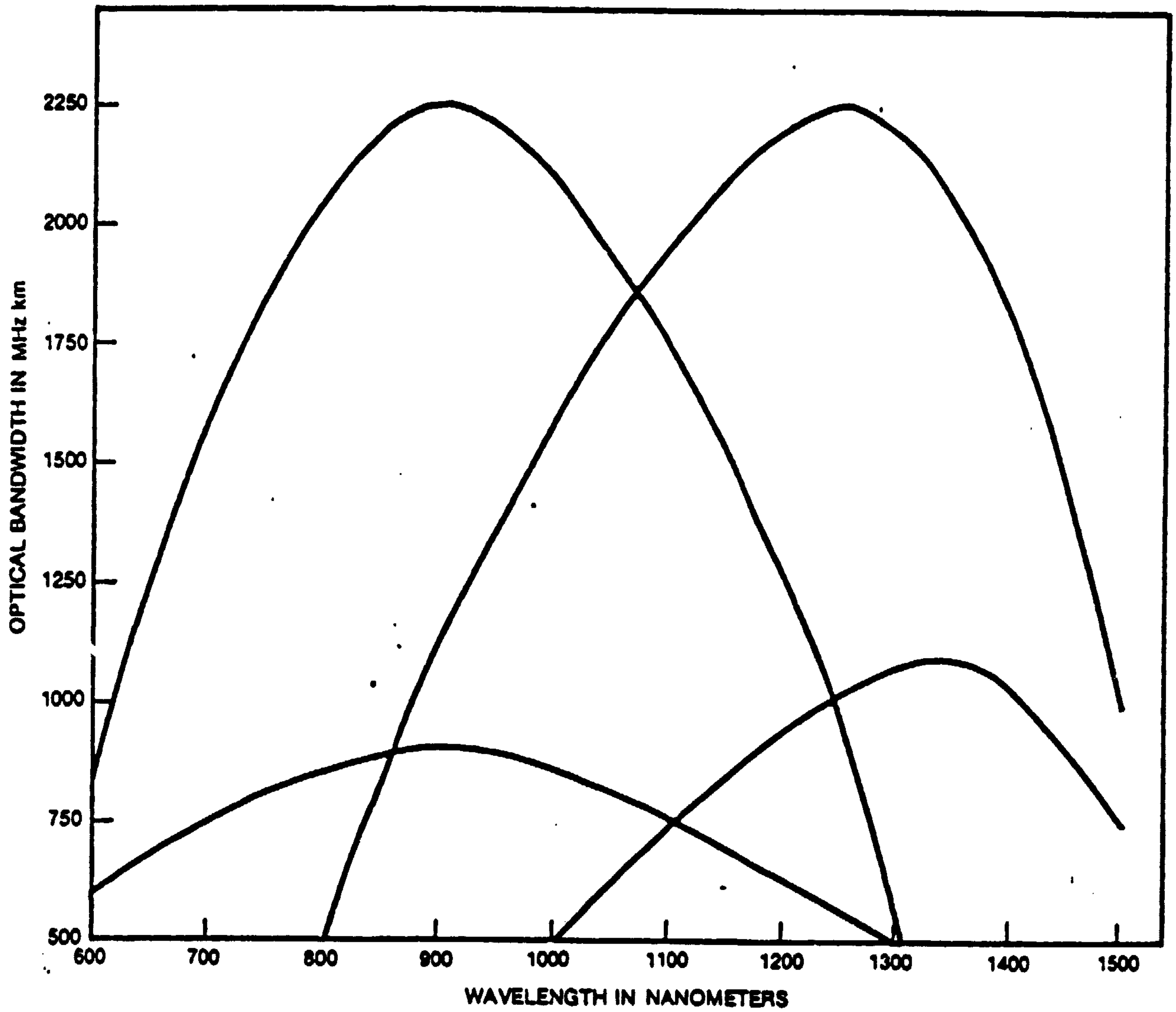
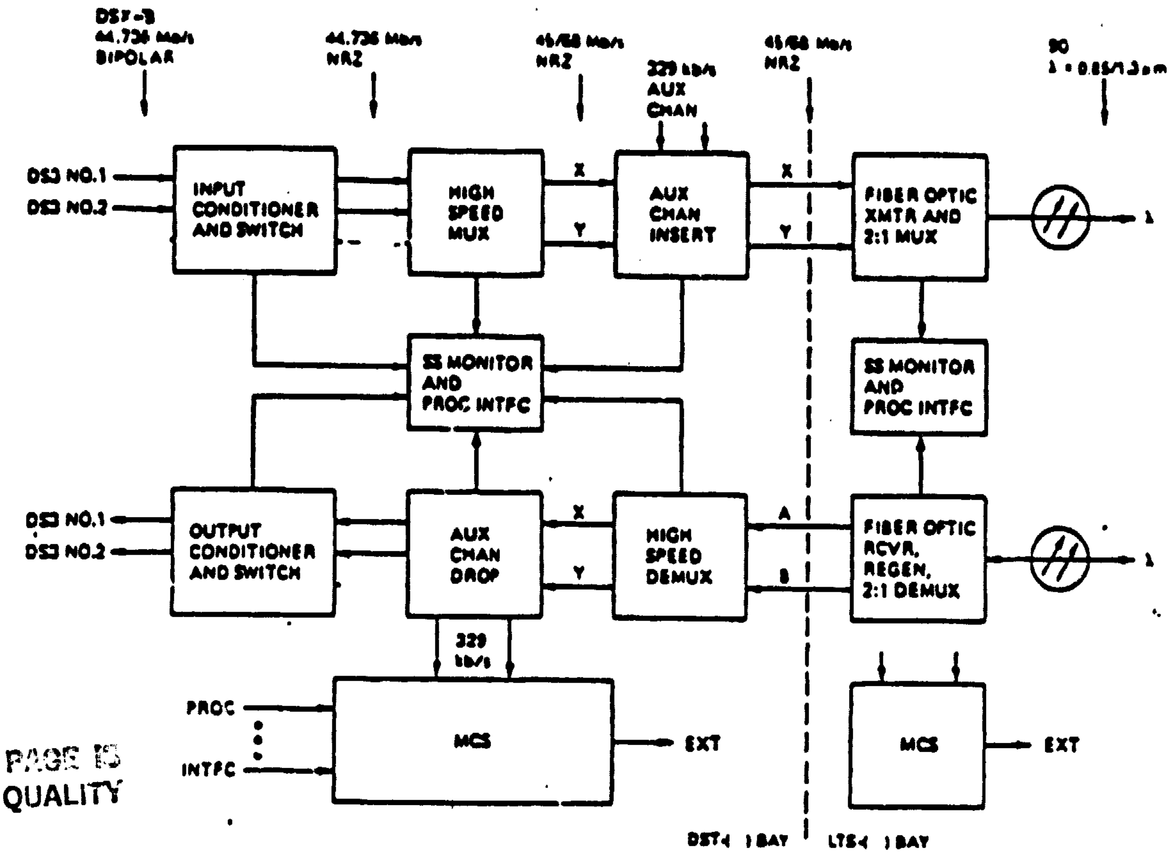
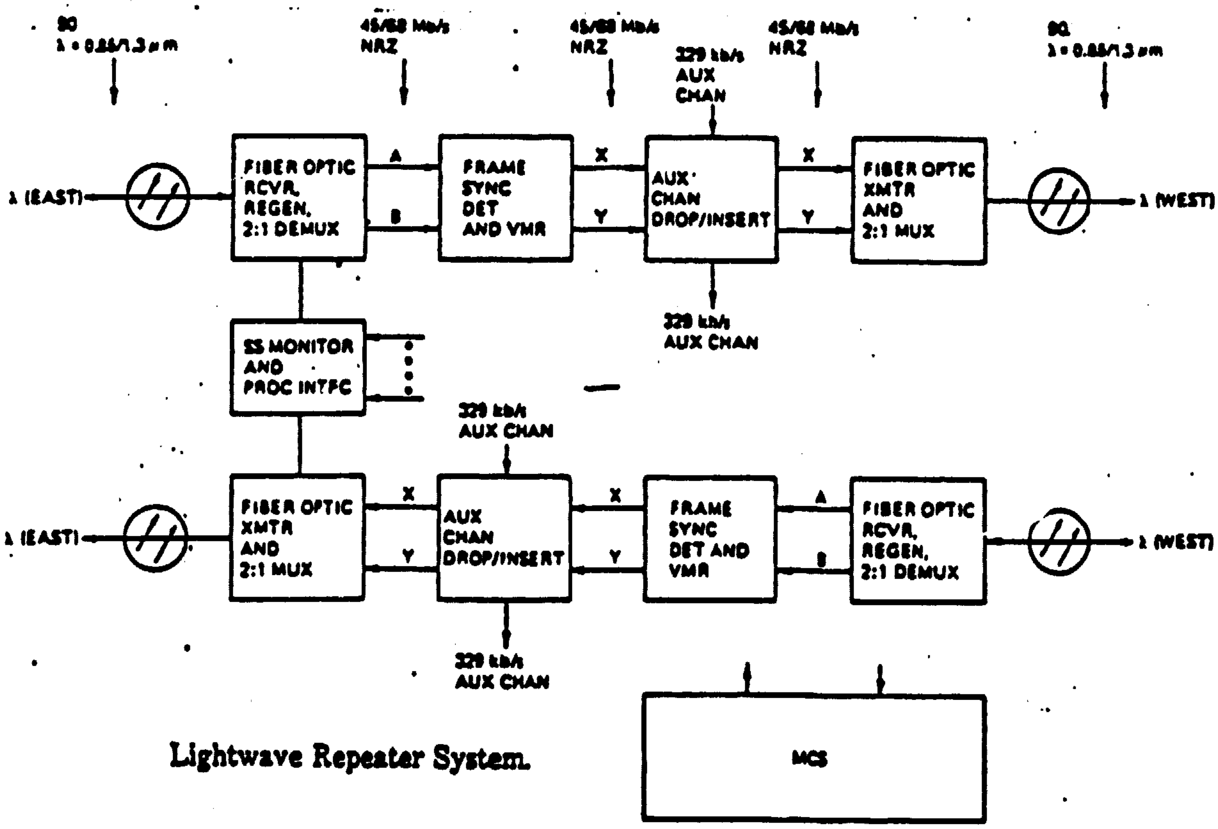


FIGURE F-18. OPTICAL FIBER BANDWIDTH VERSUS WAVELENGTH



Lightwave Terminal System.



Lightwave Repeater System.

FIGURE F-19. FIBER OPTIC SYSTEM

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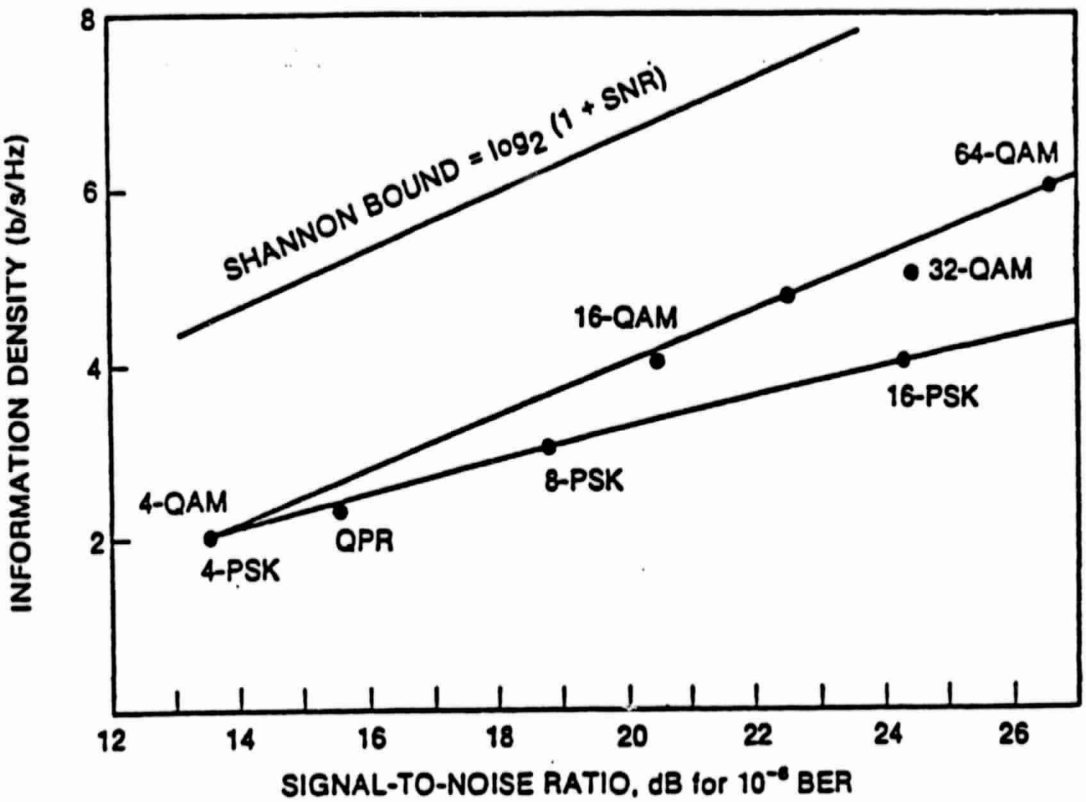

FIGURE F-20. CHANNEL CAPACITY FOR VARIOUS MODULATION SCHEMES

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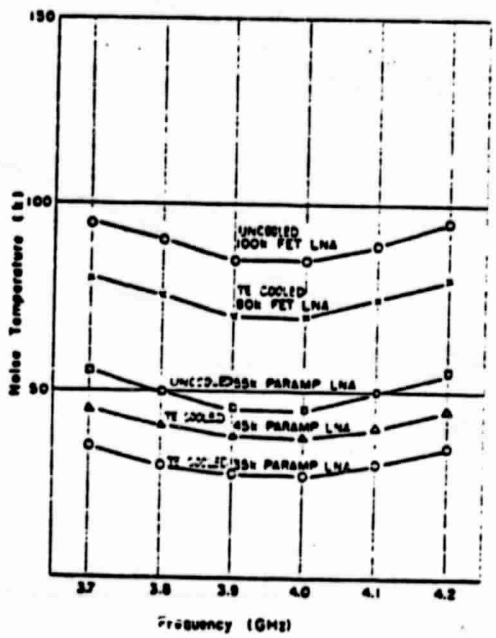

FIGURE F-21. TYPICAL NOISE TEMPERATURE OF 4 GHz LNA

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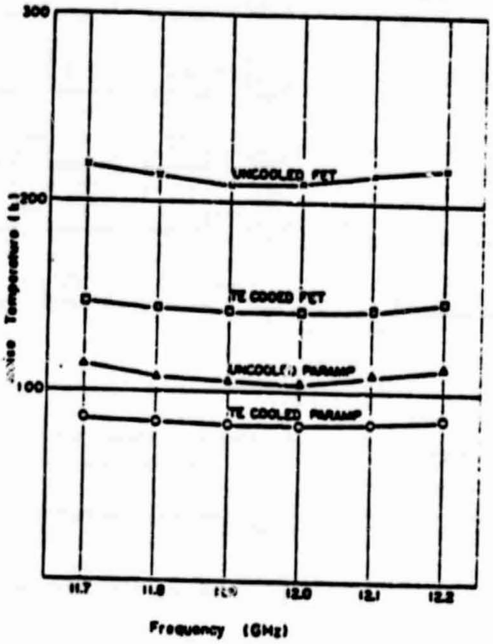

FIGURE F-22. TYPICAL NOISE TEMPERATURE OF 12 GHz LNA

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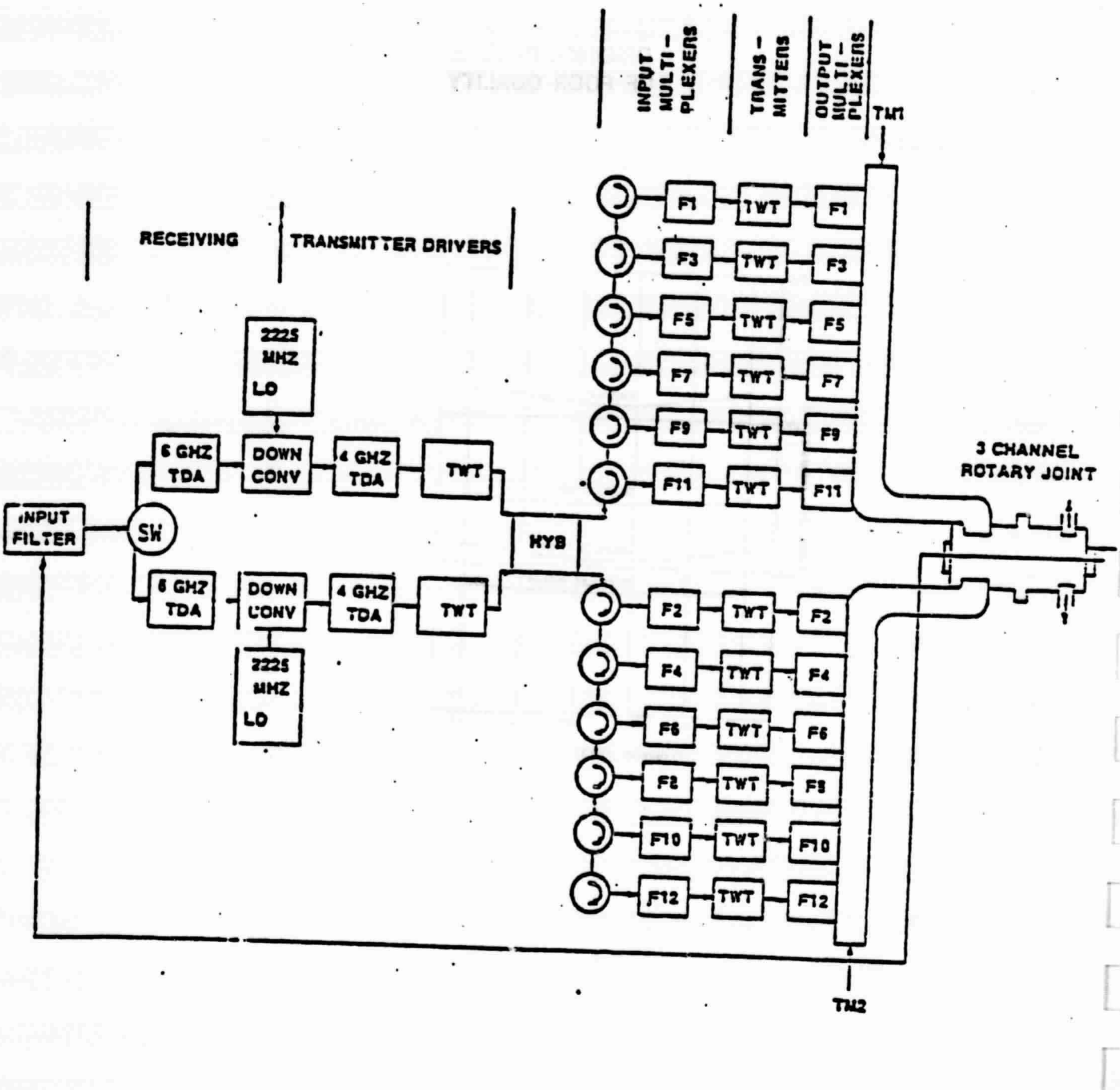

FIGURE F-23. REPEATER BLOCK DIAGRAM

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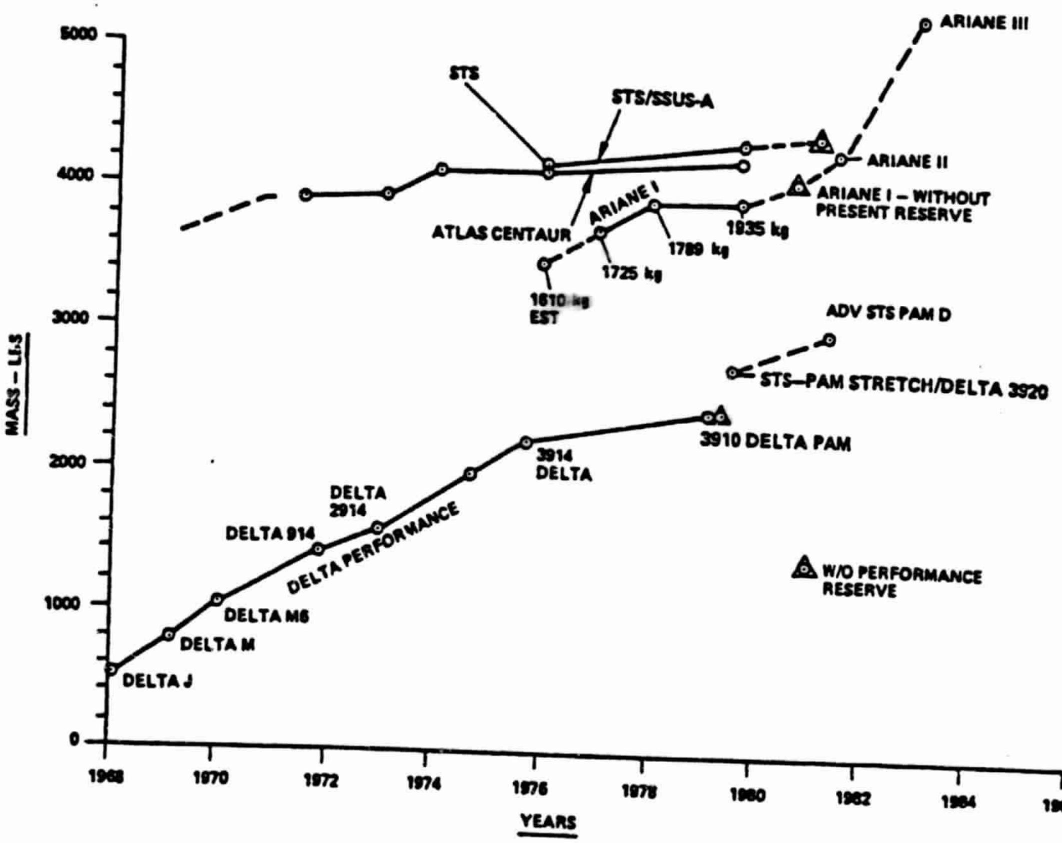

FIGURE F-24. INCREASE IN LAUNCH VEHICLE CAPABILITY

TABLE F-1. C-BAND ANTENNA COSTS
(in thousands of dollars)

DIAMETER	4m	5m	7m	10m	11m	12m
COST	2.5*	7*	33*	125	182	225

*Does not include frequency reuse.

10, 11 and 12 meter antenna cost includes the cost of antenna tracking and frequency reuse.

TABLE F-2. C-BAND LOW NOISE AMPLIFIER COSTS
(in thousands of dollars)

	40°	50°	80°	90°	120°
Nonredundant	24	17	9	10	8
Redundant	52	38	22	24	20

TABLE F-3. C-BAND TWT POWER AMPLIFIER COSTS
(in thousands of dollars)

Power output (Watts)	5	10	20	25	40	75	125	400	600	700	1 KW	3 KW
Nonredundant	2		7	10	11	16	21.5	29	36	39	82	200
Redundant unit	10		23	29	31	41	52	67	81	87	174	420

C-BAND CKLYSTRON COSTS
(in thousands of dollars)

Power output (Watts)	3	3.3
Nonredundant	47.5	55
Redundant	104.5	119.5

TABLE F-4. C-BAND FREQUENCY CONVERTER COSTS
(in thousands of dollars)

TYPE OF CONVERTER	Upconverter	Downconverter
NONREDUNDANT	9.1	8.8
REDUNDANT	19.6	19.0

TABLE F-5. COST OF TDMA TERMINALS INCLUDING MODEMS
(in thousands of dollars)

BURST RATE	60 MBPS	15 MBPS	8 MBPS
NONREDUNDANT	125	50	40
REDUNDANT	200	80	58

TABLE F-6. COST OF 60 MBPS TDMA EARTH STATIN IN $K AVAILABILITY

	.995	.999
11 Meter Antenna	182.5K	182.5K
50° LNA	21K	47.5K*
Uplink Subsystem (HPA and UC)	80K	146.7K*
Downlink Subsystem	27.3	38.8K*
TDMA Subsystem	140K	240K*
M&C Subsystem	33K	33K
Total Cost	483.8K	688.5K
Installation and Integration (40%)	193.52K	275.4
Total	677.32K	964L

*For .999 availability, all these subsystems are redundant with automatic switchover.

TABLE F-7. COST OF 15 MBPS BURST RATE TDMA EARTH STATION
(in thousands of dollars)

	AVAILABILITY	
	.995	.999
7 meter antenna	33K	33K
50° LNA	21K	47.5K
Uplink (600 watt HPA and upconverter)	45.1	106K
Downlink subsystem	15K	38.8K
TDMA subsystem	50K	80K
M&C subsystem	20K	33K
Total cost	184.1	338.3
Integration and installation (40%)	73.7	135.6
Total	258	474

TABLE F-8. COST OF 8 MBPS BURST RATE EARTH STATION
(in thousands of dollars)

	AVAILABILITY	
	.995	.999
7 meter antenna	33K	33K
100° LNA	10K	24K
Uplink Subsystem	39K	92K
Downlink Subsystem	15K	38.8K
TDMA Subsystem	40K	60K
M&C Subsystem	20L	33K
Component Costs	157K	281K
Integration (40%) and installation	62.8	112.4
Total	220K	393.2

TABLE F-9. C-BAND 1.5 MBPS SCPC LINK BUDGET

PARAMETER	UPLINK		DOWNLINK	
	7	5	7	5
EIRP at saturation	80	80	34	34
Total number of carriers	8.45 (7)	4.77 (3)	8.45 (7)	4.77 (3)
Required input backoff	10 dB	10 dB	4	4
Available EIRP	57.1	57.1	21.5 (7 carriers)	25.2 (4 carriers)
Tracking Loss	0.8	0.8	0.8	0.8
Path Loss	199.5	199.5	196.5	196.5
G/T	-6	-6	26	23
Boltzman Constant	228.6	228.6	228.6	228.6
Information Bit Rate	61.8	61.8	61.8	61.8
Channel Eb/No	16.8	16.8	17.1	17.6
Implementation Margin	3 dB	3 dB	3 dB	3 dB
Required Eb/No at BER of 10^{-6}	10.6	10.6	10.6	10.6
Margin	4 dB	4 dB	4 dB	4 dB

TABLE F-10. C-BAND SCPS VF (64 KBPS)

PARAMETERS	UPLINK 7	UPLINK 5	DOWNLINK 7	DOWNLINK 5
EIRP at Saturation	80	80	34	34
Total number of carriers	24.9	21.9	309 (24.9)	155 (21.9)
Required input backoff	10 dB	10 dB	4 dB	4 dB
Required EIRP per channel	45.1	48.1	5.1	8.1
Tracking Loss	0.8	0.8	0.8	0.8
Path Loss	199.5	199.5	196.5	196.5
G/T	-6	-6	26	23
Boltzman Constant	228.6	228.6	228.6	228.6
Information Bit Rate	48	48	48	48
Channel Eb/No	19.3	22.4	14	14
Allocated receive degradation	3 dB	3 dB	3 dB	3 dB
Required channel Eb/No	8.4	8.4	8.4	6.4
Margin	8 dB	3 dB	3 dB	3 dB

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TABLE F-11. COST OF 1.5 MBPS SCPC EARTH STATIONS USING 5 METER ANTENNA (in thousands of dollars)

	AVAILABILITY .995	.999*
5 meter antenna	7	7
100° LNA	10	24
Uplink subsystem upconverter and 40 watt HPA	21	56
Downlink subsystem	10	25
1.5 MBPS modem (QPSK)	12	24
Earth station cost	60	136
Installation and integration cost (40%)	24	54.4
TOTAL	84	190.4

*For this availability, redundant equipment is used.

R.

TABLE F-12. COST OF 1.5 MBPS SCPC EARTH STATIONS USING 7 METER ANTENNA (in thousands of dollars)

	AVAILABILITY .995	.999*
7 meter antenna	33	33
100° LNA	10	24
Uplink and subsystem upconverter and 20 Watt HPA	7	48
Downlink subsystem	10	25
1.5 MBPS QPSK modem	12	24
Earth station cost	82	154
Installation and integration cost (40%)	32.8	61.6
TOTAL	115	216

*For this availability, redundant equipment is used.

TABLE F-13. COSTS FOR 64 KBPS SCPC EARTH STATIONS USING 5 METER ANTENNA (in thousands of dollars)

	AVAILABILITY .995	.999*
5 meter antenna	7	7
100° LNA	10	24
Uplink and subsystem upconverter and 5 watt HPA	12.5	30
Downlink subsystem	10	25
QPSK modem	6	12
Earth station cost	45.5	98
Installation and integration cost (40%)	18.2	39.2
TOTAL	63.7	137.2

*Redundant earth station.

TABLE F-14. COSTS FOR 64 KBPS SCPC EARTH STATIONS USING 7 METER ANTENNA (in thousands of dollars)

	AVAILABILITY	
	.995	.999
7 meter antenna	33	33
100° LNA	10	24
Uplink and subsystem upconverter and 5 watt HPA	12.5	30
Downlink subsystem	10	25
QPSK modem	6	12
Earth station cost	7[illegible].5	124
Installation and integration cost (40%)	28.6	49.6
TOTAL	100	173.6

*Redundant earth station.

TABLE F-15. EARTH STATION COSTS FOR ANALOG VF CHANNEL SCPC
(in thousands of dollars)

	AVAILABILITY .995	.999*
5 meter antenna	7	7
100° LNA	10	24
Uplink and subsystem upconverter and 5 watt HPA	12.5	30
Downlink subsystem	10	25
IF subsystem	10.5	21
Earth station cost	50	107
Installation and integration cost (40%)	20	42.8
TOTAL	70	149.8

*Fully redundant earth station.

TABLE F-16. C BAND CPS COSTS IN THOUSANDS OF DOLLARS

ES TYPE	CAPACITY	UPLINK B.R.	DOWNLINK R.R.	AVLBLTY	EARTH STATION DESCRIPTION	ES COST	INSTLATION COST	TOTAL	# OF CARRIERS PER TRNSPNDR
Lg.	32 MBPS	60 MBPS	60 MBPS	.995	11 Meter antenna, 50° LNA 3 KW HPA	483.8	193.5	677.5K	1
"	"	"	:	.999	Same	688.5	275.4	964	1
Med.	6.3 MBPS	15 MBPS	15 MBPS	.995	7 M ant., 50° LNA 600 W HPA	184.1	73.7	258	2
"	"	"	"	.999	Same	339.8	135.6	474.6	2
Sm.	1.5 MBPS	8 MBPS	8 MBPS	.995	7 M ant., 100° LNA 300 W HPA	157	62.8	219.8	3
"	"	"	"	.999	Same	281	112	393	"
Sm	1.5 MBPS	SCPC	SCPC	.995	(a) 5 M ant., 100° LNA 40 W HPA	60	24	84	3
"	"	1.5 MBPS	1.5 MBPS	.995	(b) 7 M ant., 100° LNA 20 W HPA	82	32.8	115	7 T-1 carr.
"	"	"	"	.999	(a) 5 M ant., 100° LNA 40 W HPA	136	54.4	190.4	3 SCPC carr.
"	"	"	"	.999	(b) 7 M ant., 100° LNA	154	61.6	216	7 T-1 carr.
Mini	1 VF 64 KBPS	SCPC	SCPC	.995	5 M ant., 100° LNA 5 W	45.5	18.2	63.7	155 VF carr.
"	"	Digital 64 KBPS	64 KBPS	.999	Same	98	39.2	137.2	155 VF carr.
1 Voice channel	Analog SCPC			.995	5 M ant., 100° LNA 5 W HPA	50	20	70	60 carriers per trnspndr.
				.999	Same	107	42.8	149.8	"

TABLE F-17. KU-BAND ANTENNA COSTS
(in thousands of dollars)

Antenna Diameter	5.5	7.7	10
Cost	60	125	135
Frequency Reuse	15	15	15

NOTE: Antennas of diameters greater than or equal to 7.7 meters include the cost of antenna tracking.

TABLE F-18. KU-BAND LOW NOISE AMPLIFIER COSTS
(in thousands of dollars)

	150°K
Nonredundant	21
Redundant	50

TABLE F-19. KU-BAND HPA COSTS (IN THOUSANDS OF DOLLARS)

POWER (In Watts)	24	40	75	125	200	300	400	500	600	700	1KW	2KW
W/R*	20	--	--	31.5	39	40	45	--	65	--	140	220
R**	50	--	--	73	86	90	102	--	142	--	298	558

*N/R - non redundant

**R - redundant

TABLE F-20. FREQUENCY CONVERTER COSTS
(in thousands of dollars)

KU-BAND	Upconverter	Downconverter
NONREDUNDANT	14.5	14.5
REDUNDANT	31.5	31.5

TABLE F-21. THE ATTENUATION REQUIREMENT FOR VARIOUS U.S. ZONES FOR KU-BAND FREQUENCIES

PROPAGATION AVAILABILITY

	.996		.9992	
ZONE	UPLINK 14 GHz	DOWNLINK 12 GHz	UPLINK 14 GHz	DOWNLINK 12 GHz
1	1.9	2.7	3.0	4.1
2	2.3	3.2	5.7	4.6
3	3.4	2.9	7.4	6.5
4	5.6	4.1	10.8	10.1

Downlink margins include not only the attenuation due to rain but also the margin required to compensate for an increase in noise temperature.

TABLE F-22. TDMA APPROACH LINK BUDGET SUMMARY FOR 60 MBPS RATE

PARAMETER	UPLINK 7 METER	UPLINK 5 METER	DOWNLINK 7 METER	DOWNLINK 5 METER
Transmitter power	26 (400 Watt)	26 (400 Watt)		
Antenna gain	58.4	55.5		
EIRP (1.5 loss 6.9 backoff)	81.5	80.1	43.5	43.5
Free space loss	207.5	207.5	205.9	205.9
Tracking loss	1.2	1.6	0.8	0.4
G/T	+1.6	+1.6	33.8	31.4
Boltzman Constant	228.6	228.6	228.6	228.6
60 MBPS Information Bit Rate	77.8	77.8	77.8	77.8
Channel Eb/No	26.4	23.4	21.4	19.4
Allocated receive degradation	3 dB	3 dB	3 dB	3 dB
Eb/No required	10.6	10.6	10.6	10.6
Clear Weather Margin	12.8	8.8	7.8	5.8
System Eb/No	20.2	17.9		

TABLE F-23. COST OF KU-BAND 60 MBPS BURST RATE TDMA EARTH STATIONS
(in thousands of dollars)

	AVAILABILITY					
	.995		.999		.999	
			Rain Zones 1, 2, 3		Rain Zone 4	
Antenna	60	(5 meter)	125	(7.7 meter)	200	(11 meter)
Uplink subsystem	116.5	(1)	156	(2)	144	(3)
150° LNA	21		50		50	
Downlink subsystem	14.5		38.8		38.8	
TDMA subsystem	140		240		240	
M&C subsystem	33		33		33	
Earth station cost	385		642.8		705.8	
Installation and integration (40%)	145		257.12		282.32	
TOTAL	539		900		988	

NOTE:

1. Uplink subsystem for .995 availability consists of redundant 400 watt HPA and an upconverter.
2. Uplink subsystem consists of redundant 400 watt HPA redundant upconverter and uplink equalization.
3. Fully redundant uplink with 300 watt HPA.

TABLE F-24. 12/14 GHz, SATELLITE LINK BUDGET SUMMARY FOR 1.5 MBPS RATE

	UPLINK		DOWNLINK	
PARAMETER	7.7 METER	5.5 METER	5.5 METER	5.5 METER
EIRP for saturation	89	89	43.4	43.4
Total number of carriers	4.77	4.77	4.77	4.77
Required input backoff	7.5 dB	7.5 dB	1.5 dB	1.5 dB
Required EIRP per channel	76.7	76.7	37.2	37.2
Free space loss	207.5	207.5	205.9	205.9
Tracking loss	1.2	1.6	0.8	0.4
G/T	1.6	1.6	33.8	31.4
Information bit rate (1.5 MBPS)	71.8	71.8	71.8	71.8
Channel Eb/No	26.4	26.0	19.4	16.9
Allocated receive degradation	3 dB	3 dB	3 dB	3 dB
Required Eb/No at BER of 10^{-6}	10.6	10.6	10.6	10.6
Margin	12.8	12.4	7.3	5.5
Boltzman Constant	228.6	228.6	228.6	228.6
System Eb/No	18.6	16.11		

TABLE F-25. COST OF KU-BAND 15 MBPS BURST RATE TDMA EARTH STATIONS (in thousands of dollars)

	AVAILABILITY					
	.995		.999		.999	
			Rain Zones 1, 2, 3		Rain Zone 4	
Antenna	60	(5.5 meter)	125	(7.7 meter)	200	(11 meter)
Uplink subsystem	104.5	(1)	146	(2)	146	(2)
150° LNA	21		50	(3)	50	(3)
Downlink subsystem	14.5		38.5		38.5	
M&C subsystem	33		33		33	
15 MBPS TDMA	50		80		80	
Total earth station cost	283		517.8		593	
Installation and integration (40%)	113.2		207.2		237	
TOTAL	396.2		725		830	

NOTE:
1. Uplink subsystem consists of redundant 300 watt HPA and nonredundant upconverter.
2. Uplink subsystem consists of redundant 300 watt HPA and redundant upconverter.
3. Redundant LNA.

TABLE F-26. 12/14 GHz SATELLITE LINK BUDGET SUMMARY FOR 8 MBPS

PARAMETERS	UPLINK 7.7 METER	UPLINK 5.5 METER	DOWNLINK 7.7 METER	DOWNLINK 5.5 METER
Saturation EIRP	89	89	43.4	43.4
Number of carriers	7	7	7	7
Required backoff	8	8	3	3
EIRP available for single carriers	74	74	33.4	33.4
Free space loss	207.5	207.5	205.9	205.9
Tracking loss	1.2	1.6	0.8	0.4
G/T	1.6	1.6	33.8	31.4
Boltzman Constant	228.6	228.6	228.6	228.6
Information bit rate (8 MBPS)	69	69	69	69
Channel Eb/No	26.5	26.1	20.1	18.1
Allocated receive degradation	3 dB	3 dB	3 dB	3 dB
Required Eb/No at BER of 10^{-6}	10.6	10.6	10.6	10.6
Available margin	12.9	12.5	6.5	4.5
System Eb/No	18.0	17.5		

TABLE F-27. COST OF KU-BAND 8 MBPS BURST RATE TDMA EARTH STATIONS (in thousands of dollars)

	AVAILABILITY					
	.995		.999		.999	
			Rain Zones 1, 2, 3		Rain Zone 4	
Antenna	125	(7.7 meter)	145	(11 meter)	200	(13 meter)
Uplink subsystem	87.5	(1)	92.2	(2)	92.2	(2)
150° LNA	21		50	(3)	50	(3)
Downlink subsystem	14.5		38.8		38.8	
M&C subsystem	33		33		33	
8 MBPS TDMA terminal	40		60		60	
Earth station cost	321		419		474	
Integration	128.4		167.6		189.6	
TOTAL	449.4		586.6		663.6	

NOTE:
1. Uplink subsystem consists of upconverter and redundant 100 watt HPA.
2. The uplink subsystem consists of fully redundant upconverters and 25 watt HPA.
3. Fully redundant LNA.

C-5

TABLE F-28. KU-BAND 1.5 MBPS SCPC 15 CARRIERS

PARAMETER	UPLINK 7.7 METER	UPLINK 5.5 METER	DOWNLINK 7.5 METER	DOWNLINK 5.5 METER
Uplink EIRP for Transponder Saturation	89.0	89.0	43.4	43.4
Total number of carriers	12.0	12.0	12.0	12.0
Required input backoff	10 dB	10 dB	4.0	4.0
Required EIRP per channel	67 dB (64 dB)	64 dB	27.4	27.4
Path loss	207.5	207.5	205.9	205.9
Tracking los	1.2	1.6	0.8	0.4
G/T	1.6	1.6	33.8	31.4
Boltzman Constant	228.6	228.6	228.6	228.6
Information bit rate (1.544 MBPS)	61.8	61.9	61.9	61.9
Channel Eb/No	23.7	23.2	21.2	19.2
Allocated receive degradation	3 dB	3 dB	3 dB	3 dB
BER = (10^{-6}) required Eb/No	10.6	10.6	10.6	10.6
Margin	10.1	9.8	7.6	5.6
System Eb/No	19.3	17.7		

TABLE F-29. SCPC VF

Number of carriers 562

For VD BER of 10^{-6} is enough

PARAMETER	UPLINK 7.5 METER	UPLINK 5.5 METER	DOWNLINK 7.5 METER	DOWNLINK 5.5 METER
Uplink EIRP for transponder saturation	89.0 dBw	89.0 dBw	43.4	43.4
Total number of carriers	27.5 dB	27.5	27.5	27.5
Required input backoff	10.0 dB	10.0 dB	4.0 dB	4.0 dB
Required EIRP per channel	51.5	51.5	11.9	11.9
Path loss	207.6	207.5	205.9	205.9
Tracking loss	1.2	1.6	0.8	0.4
G/T	1.6	1.6	33.8	31.4
Boltzman Constant	228.6	228.6	228.6	228.6
Information bit rate (64 KBPS)	48	48	48	48
Channel Eb/No	25	24.6	19.6	17.6
Allocated receive degradation	3 dB	3 dB	3 dB	3 dB
Required Eb/No	10.6 (BER 10^{-6}) 8.4 (BER 10^{-4})	10.6	10.6	10.6
Available Margin BER 10^{-6}	11.4	11	6	4
Available Margin BER 10^{-4}	13.6	13.2	8.2	6.2

TABLE F-30. COST OF KU-BAND 1.5 MBPS SCPC EARTH STATIONS
(in thousands of dollars)

	AVAILABILITY					
	.995		.999		.999	
			Rain Zones 1, 2, 3		Rain Zone 4	
Antenna	60	(5.5 meters)	125	(7.7 meters)	145	(11 meter)
Uplink subsystem	64.5	(1)	56.7	(2)	56.7	(2)
LNA	21		50	(3)	50	(3)
Downconverter	14.5		38.5		38.8	
1.5 MBPS QPSK modem	12		24		24	
Earth station cost	172		282.5		302.5	
Integration and installation (40%)	68.8		113		121	
TOTAL	240.8		395.5		423.5	

NOTE:
1. Uplink subsystem consists of upconverter and redundant 24 watt HPA.
2. The uplink subsystem consists of fully redundant upconverters and 10 watt HPA.
3. Fully redundant LNA.

TABLE F-31. COST OF KU-BAND 64 KBPS SCPC EARTH STATIONS
(in thousands of dollars)

	AVAILABILITY					
	.995		.999		.999	
			Rain Zones 1, 2, 3		Rain Zone 4	
Antenna	50	(5.5 meters)	125	(7.7 meters)	145	(11 meter)
Uplink subsystem	34.5	(1)	56.7	(2)	56.7	(2)
LNA	21		50	(3)	50	(3)
Downconverter	14.5		38.8		38.8	
QPSK modem	6		12		12	
SCPC earth station cost	136		288.5		308.5	
Integration and installation (40%)	54.4		155.4		123.4	
TOTAL	190		404		431.9	

NOTE:
1. Uplink subsystem consists of upconverter and redundant HPA.
2. The uplink subsystem consists of fully redundant upconverters and 10 watt HPA.
3. Fully redundant LNA.

TABLE F-32. KU BAND CPS ES COSTS IN THOUSANDS OF DOLLARS

			Rate in MBPS							
ES Type	Capacity	Approach	Uplnk	Dnlnk	Avlblty	Earth Station Description	ES Cost	Instlation & Integrtn	Total	# of Carriers per Trnspndr
Lg.	32 MBPS	TDM	60	60	.995	5 Meter antenna 150° LNA 42 Watt HSA	385	154	539	single carrier
Lg.	"	"	"	"	.999	7.7 M Antenna Redundant Earth Station (Rain Zones 1, 2, 3)	642.8	257.12	900	"
Lg.	"	"	"	"	.999	Same as above with 11 meter antenna	705.8	282.32	988	"
Med.	6.3 MBPS	TDMA	60	60	.995	5.5 Meter antenna 150° LNA 42 Watt HSA	385	154	539	single carrier
Med.	"	"	"	"	.999	7.7 M ant., 42 WHSA 150° LNA (FR) RZ 1, 2, 3	642.8	257.12	900	"
Med.	"	"	"	"	.999	Same as above but with 11 M ant. for RZ 4	705.8	282.32	988	"
Sm.	For TDMA approach the costs are same as given above									
Med. & Sm.	6.3/1.5	TDMA	15	15	.995	5.5 M Ant. 300 WHPA 150° LNA	283	113.2	396.2	3 carriers
"	"	"	"	"	.999	7 M ant., 300 WHPA 150° LNA (RZ 1, 2, 3)	517.8	207.2	725	"
"	"	"	"	"	.999	11M ant, 300 WHPA	593	237	830	"
Sm/ Mini	1.5 MBPS	TDMA	8	8	.995	7.7 M ant, 12 WHPA 150° LNA	321	128.4	449.4	5 carrier per transponder
"	"	"	"	"	.999	11 M ant, 25 WHPA 150° LNA (RZ 1, 2, 3)	419	167.6	585.6	"
"	"	"	"	"	.999	13 M ant. for RZ 4	474	189.6	663.6	"

TABLE F-32. KU BAND CPS ES COSTS IN THOUSANDS OF DOLLARS

ES Type	Capacity	Approach	Rate in MBPS Uplnk	Dnlnk	Avlblty	Earth Station Description	ES Cost	Instlation & Integrtn	Total	# of Carriers per Trnspndr
Sm.	1.5 MBPS	SCPC	1.5	1.5	.995	5.5 M ant., 25 WHPA 150° LNA	172	68.8	240.8	16 T-1 carriers
"	"	"	"	"	.999	7 M ant., RZ 1, 2, 3	282.5	113	395.5	"
"	"	"	"	"	.999	11 M ant., RZ 4	302.5	121	423.5	
Mini	64 KBPS	SCPC	64 KBPS	64 KBPS	.995	5.5 M ant., 10 WHPA 150° LNA	136	54.4	190	5 62 carriers
"	"	"	"	"	.999	7 M ant. for RZ 1, 2, 3	288.5	115.4	404	"
"	"	"	"	"	.999	11 M ant. for RZ 4	308..	123.4	431.9	"

TABLE F-33. CPS SYSTEM CHARACTERISTICS

EARTH STATION CAPACITY	UPLINK RATE	DOWNLINK RATE	APPROACH	EIRP/BEAM	G/T PER BEAM	BEAM WIDTH
32 MBPS	128 MBPS	256 MBPS	TDMA	66 dBw	18 dB/°K	0.3°
6.3 MBPS	32 MBPS	128 MBPS	TDMA	66 dBw	18 dB/°K	Same for up and downlink
1.544 MBPS	32 MBPS	128 MBPS	TDMA	66 dBw	18 dB/°K	
64 KBPS	8 MBPS	128 MBPS	TDMA	66 dBw	18 dB/°K	
6.3	6.3	6.3	FDMA	61 - 49 dBw	18 - 6 dB/°K	0.3 - 1.2°
1.5	1.5	1.5	FDMA	61 - 49 dBw	18 - 6 dB/°K	
0.064	0.064	0.064	FDMA	61 - 49 dBw	18 - 6 dB/°K	
6.3	6.3	256	Hybrid	66 dBw	18 - 6 dB/°K	0.3 - 1.2° for uplink
1.5	1.5	128	Hybrid	66 dBw		0.3° downlink
0.064	0.064	128	Hybrid	66 dBw		

TABLE F-34. RAIN ATTENUATION IN dB FOR SATELLITE AT 90°W (SINGLE LINK)

(20 GHz)

Zone	Elevation Angle	Percent of the Time Attenuation is Exceeded 0.01	0.05	0.1	0.5	1.0
B	35	13	6	4	1	1
C	30	20	8	5	1	1
D_1	40	23	9	6	2	1
D_2	45	28	12	8	3	1
D_3	50	36	17	12	3	2
E	55	55	29	20	4	2
F	40	17	6	4	2	1

(30 GHz)

Zone	Elevation Angle	Percent of the Time Attenuation is Exceeded 0.01	0.05	0.1	0.5	1.0
B	35	29	13	9	3	2
C	30	45	17	11	3	2
D_1	40	50	21	14	4	2
D_2	45	63	28	18	6	3
D_3	50	80	39	27	8	4
E	55	120	64	43	10	4
F	40	37	13	9	4	2

TABLE F-35. LINK BUDGFT FOR LARGE KA BAND EARTH STATION

UPLINK = 128 MBPS DOWNLINK = 256 MBPS

ITEM	UPLINK 27.5 GHz	DOWNLINK 17.7 GHz
Transmitter Power	10 db (10 Watts)	
Transmitter Gain	61.2 ddb	
EIRP (pointing loss + 2 db line losses)	69.9 dbw	66 dbw
Free Space Loss	213.	209.2 db
Atmospheric Loss	0.6	0.8 db
(G)/T Sat. db/°k	18.0	27.8 db/°k
Boltzman constant	228.6	228.6
Info bit rate	81.0	84
Channel Eb/No	18.9	25.4
Allocated Rx degradation	3.0	3.0
Eb/No required at 10^{-6}	10.6	10.6
Clear weather margin	(5.3) 20 db is maximum useful margin.	(11.8) 10 db is probably maximum useful margin.

TABLE F-36. ACHIEVABLE AVAILABILITY WITH ADAPTIVE FEC AND ADAPTIVE POWER CONTROL

ENVIRONMENT	TYPE OF EARTH STATION LINK					
	LARGE EARTH STATION		SMALL & MEDIUM		MINI	
	UPLINK	DOWNLINK	UPLINK	DOWNLINK	UPLINK	DOWNLINK
Clear Weather	5.3	11.8	5.2	11.2	4.7	7.7
	Uplink limited - class 2 to all zones except D2, D3, & E		Uplink limited - class 2 to all zones except D2, D3, & E		Uplink limited - class 2 to all zones except D2, D3, & E	
Clear Weather + FEC of 8.2 db	14.1	11.8*	14.0	11.2*	13.5	7.7*
	Class 2 to all except D3, E Class 1 to all except D2, D3, E		Class 2 to all except D3, E Class 1 to all except D2, D3, E		Class 2 to all except D3, E	
Clear Weather, FEC, & Power Boost	20.0	11.8**	20.0	11.2**	20.0	10.0**
	Class 2 to all except E Class 1 to all except D3, E		Class 2 to all except E Class 1 to all except D3, E		Class 2 to all except E Class 1 to all except D2, D3, E	

Class 1 = 0.999 end-end availability
Class 2 = 0.995 end-end availability

*Adding FEC would exceed the 10 db practical downlink margin.
**Total margin limited to about 10 db.

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TABLE F-37. LINK BUDGET FOR SMALL AND MEDIUM KA BAND EARTH STATIONS

UPLINK BR = 32 MBPS DOWNLINK BR = 128 MBPS

ITEM	UPLINK 27.5 GHz	DOWNLINK 17.7 GHz
Transmitter Power (dbw)	10 db (10 Watts)	
Transmitter Antenna Gain db	56.8	
Pointing Loss db	1.0 db	
EIRP with 2 db line loss dbw	63.8	[illegible] dbw
Free Space Loss db	213	209
Atmospheric Loss db	0.6	0.8
(G)/T Sat db/°k	18 db	24
Pointing and Diplexer Loss	3.0	3.0
Boltzman Constant	228.6	228.6
Info Bit Rae	75.0	81
Channel Eb/No	18.8	24.8
Allocated Receive Degradation	3.0	3.0
Eb/No Required	10.6	10.6
Clear Weather Margin	5.2	11.2

TABLE F-38. LINK BUDGET FOR MINI KA-BAND EARTH STATION

UPLINK BR = 8 MBPS DOWNLINK BR = 128 MBPS

ITEM	UPLINK 27.5 GHz	DOWNLINK 17.7 GHz
Transmitter Power dbw	7 db	
Transmitter Antenna Gain	53.3	
Pointing Loss	1 db	
EIRP with 2 db Line Loss	57.3	66 dbw
Free Space Loss	213	209
Atmospheric Loss	0.6	0.8
(G)/T Sat db/°k	18	20.5
Pointing Diplexer Loss	3	3
Boltzman Constant	228.6	228.6
Info Bit Rate	69.0	81.0
Channel Eb/No	18.3	21.3
Allocated Receiver Degradation	3	3
Eb/No Required	10.6	10.6
Clear Weather Margin	4.7	7.7

20 db is maximum useful margin

TABLE F-39. KA-BAND TERMINAL COSTS (1980 $K)

	FDMA		TDMA	
	COST (W/N*)	CAPACITY	COST	CAPACITY
HIGH (32 MBS)	969/830	238	330	440
MED (6.3 MBS)	471/359	68	233	88
LOW (1.5 MBS)	329/165	14	208	22
MINI (65 KBS)	95/85	1	109	1

*W - 1.2 degree spacecraft beams
N - 0.3 degree spacecraft beams

TABLE F-40. PRIMARY OPERATIONAL SATELLITE CHARACTERISTICS (C-BAND)

PARAMETER	TYPE OR VALUE
Launch vehicle	Delta 3910/PAM
Satellite mission life/design life	8.5 years, minimum/10 years
North-south stationkeeping accuracy	$\pm 0.1°$
East-west stationkeeping accuracy	$\pm 0.1°$
Eclipse capability	100% (24 channels)
Stabilization	Spin stabilized
RF output power per TWTA	8 watts
Communications channelization	24 operational 36 MHz transponder channels
Communications EIRP per transponder	CONUS: 34 dBW
Communication receive G/T	CONUS: -7.2 dB/K
6/4 Communications frequencies	
Transmit	3.7 to 4.2 GHz
Receive	5.925 to 6.425 GHz
TT&C EIRP	7.9 dBW, reflector antenna 5.0 dBW, bicone antenna
TT&C receive G/T	-23.3 dB/K, reflector antenna -43.4 dB/K, bicone antenna worst case
TT&C frequencies	
Telemetry	4198 MHz
Command	5.923 to 5.930 GHz, transfer orbit 6.420 to 6.425 GHz, on-station
Communications polarization	
Transmit	12 channel linear horizontal, 12 channel linear vertical
Receive	12 channel linear vertical, 12 channel linear horizontal
TT&C polarization	
Telemetry	Transfer orbit vertical On-station, horizontal
Command	Transfer orbit horizontal On-station, vertical

TABLE F-41. REPRESENTATIVE SPACECRAFT WEIGHT BUDGET (C-BAND)

Subsystem Identification	Weight, lb
Launch vehicle (Delta 3910/PAM) payload	2380
AKM consumables	1076
Hydrazine (includes 8.5 yr stationkeeping)	274
Dry satellite	1030
Communications (include antenna)	256
Reaction control (dry)	29
Attitude control	52
Thermal control	44
Telemetry, tracking, and command	59
AKM case at burnout	64
Structure	200
Electrical power (includes harness)	274
Balance and miscellaneous	12
Contingency	40

TABLE F-42. CHANNEL CENTER FREQUENCY ASSIGNMENTS (C-BAND)

Earth-to-Space		Space-to-Earth	
Assigned Freq. MHz	Polarization*	Assigned Freq. MHz	Polarization*
5945	V 1	3720	H 1
5965	H 1	3740	V 1
5985	V 2	3760	H 2
6005	H 2	3780	V 2
6025	V 3	3800	H 3
6045	H 3	3820	V 3
6065	V 4	3840	H 4
6085	H 4	3860	V 4
6105	V 5	3880	H 5
6125	H 5	3900	V 5
6145	V 6	3920	H 6
6165	H 6	3940	V 6
6185	V 7	3960	H 7
6205	H 7	3980	V 7
6225	V 8	4000	H 8
6245	H 8	4020	V 8
6265	V 9	4040	H 9
6285	H 9	4060	V 9
6305	V 10	4080	H 10
6325	H 10	4100	V 10
6345	V 11	4120	H 11
6365	H 11	4140	V 11
6385	V 12	4160	H 12
6405	H 12	4180	V 12

TABLE F-43. PRIMARY OPERATIONAL SATELLITE CHARACTERISTICS (KU-BAND)

PARAMETER	
Satellite mission life/design life	10 years
North South station keeping accuracy	±0.05
East West station keeping accuracy	±0.05
R F output power per TWTA	20 watt/30 watt
Communication Channelization	16 operational, 54 MLZ transponder channels.
Communication EIRP/Transponder	40-47 dbw
Communication Receive c/t	+1.6 db/op
12/14 communication frequencies	
Transmit	11.7 - 12.2 GLZ
Receive	14 to 14.5

TABLE F-44. REPRESENTATIVE SPACECRAFT WEIGHT BUDGET (KU-BAND)

Sub System Identification	Weight
Total lift off weight	2769 lbs.
Communication payload weight	300 lbs.
Bus Sub System weight	849 lbs.
Total Propellent	290 lbs.
AKM expendables	1295 lbs.
Margin	3611 lbs.

TABLE F-45. CANDIDATE 3 and 5 GBPS CPS SYSTEM CHARACTERISTICS (KA-BAND)

	3 GBPS			5 GBPS		
	TDMA	FDMA	HYBRID	TDMA	FDMA	HYBRID
NO. FIXED BEAMS		20	20		20	20
NO. SCANNING BEAMS	6		6	10		10
BEAMWIDTH	0.3°	0.3-1.2°	0.3-1.2°/0.3°	0.3°	0.3-1.2°	0.3-1.2°/0.3°
EIRP (PER BEAM)	66 dBW	61-49 dBW	66 dBW	66 dBW	61-49 dBW	66 dBW
G/T (PER BEAM)	18 dB/K	18-6 dB/K	18-6 dB/K	18 dB/K	18-6 dB/K	18-6 dB/K
UPLINK RATE (MBPS)	8, 32, 128	0.064, 1.5, 6.3	0.064, 1.5, 6.3	8, 32, 128	0.064, 1.5, 6.3	0.064, 1.5, 6.3
DOWNLINK CHANNEL RATE	128, 256	0.064, 1.5, 6.3	128, 256	128, 256	0.064, 1.5, 6.3	128, 256
ERROR CONTROL	FEC	POWER	FEC, POWER	FEC	POWER	FEC, POWER
COVERAGE (% CONUS)	60	60	60	65	65	65

TABLE F-46. 30/20 GHz CPS SYSTEM SPACECRAFT WEIGHT AND POWER ESTIMATES

	3 Gbps			5 Gbps			10 Gbps
	TDMA	FDMA	HYBRID	TDMA	FDMA	HYBRID	COMPOSITE
PAYLOAD							
PWR (WATTS)	1205	2802	4122	1775	3628	6835	2446
WT*	334	1692	1749	551	2462	2860	887
ACS							
WT	120	130	130	123	136	140	126
TT&C							
WT	82	122	126	90	146	158	98
T/C							
WT	17	41	41	22	51	56	28
EPS							
WT	583	1098	1382	757	1414	2239	820
STRUCTURAL							
WT	250	1100	1150	420	1260	1390	666
PROPELLANT							
WT	870	2108	2270	1109	2640	3137	1380
W_D (LBS)	2094	5070	5465	2671	6356	7836	3332
W_{BOL} (LBS)	2964	7176	7735	3780	8996	10972	4712

*WT = WEIGHT IN POUNDS

W_D = TOTAL DRY WEIGHT OF SPACECRAFT (INCLUDES ANTENNAS AND RCS DRY WEIGHT)

W_{BOL} = TOTAL WEIGHT OF SPACECRAFT BEGINNING OF LIFE

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TABLE F-47. KA-BAND CPS SPACE SEGMENT COSTS IN MILLIONS OF DOLLARS

Cost	3 Gbps TDMA	5 Gbps TDMA	10 Gbps TDMA
NR	180	220	280
R x 2	80	100	140
Launch XI	24	24	24
MCF	40	40	40
TOTALS	324	384	484

NR (spacecraft, propulsion, integration)
R (spacecraft, propulsion, integration) x 2
MCF (Master Control Facility NR + R)

TABLE F-48. INITIAL INVESTMENT IN MILLIONS OF DOLLARS FOR KA-BAND CPS SYSTEM

COST	3 GBPS TDMA	5 GBPS TDMA	10 GBPS TDMA
NR	180.0	220.0	280.0
R x 2	80.0	100.0	140.0
Launch x 1	24.0	24.0	24.0
MCF	40.0	40.0	40.0
Insurance Cost	10.9	12.6	16.0
TOTALS	334.9	396.6	500.0

The above does not include O&M costs which is 2 million dollars/year.

TABLE F-49. 6 GHz DIGITAL RADIO TERMINAL
(in thousands of dollars)

ITEM	COST
Radio Equipment	52.0
Fault and Alarm System	9.0
Antenna and Waveguide	10.0
Civil Works	12.0
Tower	17.0
Power	11.0
Land/Site (Acquisition)	3.0
Field Survey and FCC Coordination	7.0
Miscellaneous (Documentation, etc.)	19.0
Test Equipment	25.0
Spares	20.0
Installation	39.0
TOTAL	224.0

TABLE F-50. 6 GHz DIGITAL RADIO REPEATER
(in thousands of dollars)

ITEM	COST
Radio Equipment	104.0
Fault and Alarm System	5.1
Antenna and Waveguide	16.0
Civil Works	32.0
Tower and Buildings	36.0
Power	13.0
Land and Acquisition	24.0
Site Selection and FCC	7.0
Miscellaneous (Documentation, etc.)	10.0
Test Equipment	5.0
Spares	10.6
Installation	64.3
TOTAL	327.0

TABLE F-51. COSTS OF DIGITAL MULTIPLEX EQUIPMENT (INSTALLED)
(in thousands of dollars)

ITEM	COST
Digital Multiplexer	
Common Equipment (M13 MUX)	20
DS2 Interface (14 DS2)	17
DS1 Interface (56 DS1)	22
D3 Banks (56 DS1)	476
56 KPS Channels (1344 Channels)	1,612
VF Channels (1344 Channels)	162

TABLE F-52. 90 MBPS DIGITAL RADIO ANNUAL COSTS PER CHANNEL
(in thousands of dollars)

DISTANCE (KM)	DS2	DS1	56 KBPS	VF
100	26.0	6.8	1.3	0.6
200	41.8	10.5	1.5	0.8
300	64.3	16.1	1.7	1.0
400	79.2	20.0	1.8	1.2
500	101.6	25.5	2.1	1.4
600	116.6	29.2	2.2	1.5
700	139.0	35.0	2.5	1.8
800	154.0	38.5	2.6	1.9
900	183.8	46.0	2.9	2.2
1000	198.7	49.7	3.1	2.4
2000	385.6	96.5	5.0	4.3
3000	572.5	143.2	7.0	6.3

TABLE F-53. 90 MBPS FIBER OPTIC SYSTEM COSTS
(in thousands of dollars)

1. Basic Terminal	
Optical Terminal	29.0
Fault and Alarm System	8.0
Power System	16.0
Test Equipment	20.0
Spares	8.0
Miscellaneous	10.0
Installation	24.0
TOTAL	115.0
2. Repeater Location	
Optical Repeater	32.0
Charger and Batteries	1.5
Enclosure	3.5
Installation	13.0
TOTAL	60.0
3. Cable	
Material	3.8 per KM
Installation	
Large City	10.0 per KM
Suburbs	7.0 per KM
Rural	3.0 per KM

TABLE F-54. ANNUAL COSTS OF 90 MBPS FIBER OPTIC
(in thousands of dollars)

DISTANCE	DS2	DS1	56 KBPS	VF
100	64.0	16.0	1.9	1.1
500	288.0	72.0	4.27	3.4
1000	567.0	142.0	7.2	6.3
1500	846.6	212.0	10.1	9.2

TABLE F-55. ANNUAL COST (USER-TO-USER) USING 90 MBPS FIBER OPTIC SYSTEM

DISTANCE	DS1	56 KBPS	9.6 KBPS	4.8 KBPS	2.4 KBPS	VF
100	65.4	17.4	3.7	2.1	1.3	1.3
500	289.4	73.4	4.2	2.3	1.4	3.6
1000	568.4	143.4	4.8	2.6	1.5	6.5
1500	848.0	213.4	5.4	2.9	1.6	9.4

TABLE F-56. ANNUAL COST (USER-TO-USER) USING 90 MBPS RADIO

DISTANCE	DS1	56 KBPS	9.6 KBPS	4.8 KBPS	2.4 KBPS	VF
100	8.2	2.7	3.6	2.1	1.2	0.8
200	11.9	2.9	3.7	2.1	1.2	1.0
300	17.5	3.1	3.7	2.1	1.2	1.2
400	21.4	3.2	3.7	2.1	1.3	1.4
500	26.9	3.5	3.8	2.1	1.3	1.6
600	30.6	3.6	3.8	2.2	1.3	1.7
700	36.4	3.9	3.9	2.2	1.3	1.8
800	39.9	4.0	3.9	2.2	1.3	1.9
900	47.4	4.3	3.9	2.2	1.3	2.4
1000	51.1	4.5	4.0	2.2	1.3	2.6
2000	97.9	6.4	4.4	2.2	1.4	4.5
3000	144.6	8.4	4.8	2.6	1.5	6.5

TABLE F-57. DIGITAL RADIO COSTS
(In Thousands of Dollars per Channel per Year)

DISTANCE	DS2 1990	DS2 2000	DS1 1990	DS1 2000	56 KBPS 1990	56 KBPS 2000	VF 1990	VF 2000
100	19.5	16.6	4.1	3.5	1.0	0.9	0.5	0.4
200	31.4	26.7	7.9	6.7	1.1	0.9	0.6	0.5
300	48.2	41.0	12.1	10.3	1.3	1.1	0.8	0.7
400	59.4	50.5	15.0	12.8	1.4	1.2	0.9	0.8
500	76.2	64.8	19.1	16.2	1.6	1.4	1.1	0.9
600	87.5	74.4	21.9	18.6	1.7	1.5	1.1	0.9
700	104.3	88.7	26.3	22.4	1.9	1.6	1.4	1.2
800	115.5	98.2	29.0	24.6	2.0	1.7	1.4	1.2
900	137.9	117.2	34.5	29.3	2.2	1.9	1.7	1.4
1000	149.0	126.7	37.3	31.7	2.3	2.0	1.8	1.5
2000	289.2	245.8	72.4	61.5	3.8	3.2	3.2	2.7
3000	429.5	365.1	107.4	91.3	5.3	4.5	4.7	4.0

TABLE F-58. 90 MBPS FIBER OPTIC SYSTEMS
(In Thousands of Dollars)

DISTANCE	DS2		DS1		56 KBPS		VF	
	1990	2000	1990	2000	1990	2000	1990	2000
100	44.8	39.9	11.2	10.0	1.3	1.1	0.8	0.7
500	201.6	179.4	50.4	44.9	3.0	2.5	2.4	2.1
1000	396.9	353.2	99.4	88.5	5.0	4.1	4.4	3.7
1500	592.6	527.4	148.4	132.1	7.1	5.8	6.4	5.4

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TABLE F-59. C BAND ANNUAL RECURRING COST OF THE SYSTEM
(in thousands of dollars)

E(S) Type	Capacity FDX	Availability.	Earth Seg. Cost	Space Seg. Cost	NCC Cost	Total
Large	32 FDX MBPS	.995	556.0	1820	12	2388
		.999	790	1820	12	2622
Medium BR = 60 MBPS	6.3 FDX MBPS	.995	677.5	357	12	1046.5
		.995	790	357	12	1159
Medium BR = 15 MBPS	6.3 FDX MBPS	.995	211.56	714	12	938
		.999	389.2	714	12	1116
Small BR = 15 MBPS	1.5 MBPX	.995	211.56	170	12	397.0
		.999	389.2	170	12	571.2
Small BR = 8 MBPS	1.5 MBPS	.995	180.2	213	12	404.7
		.999	322.3	213	12	546.8
Small SCPC Approach	1.5 MBPS	.995	94.3	486	12	592
		.999	177.2	486	12	675
Mini BR = 8 MBPS	64 KBPS	.995	180.2	9.1	12	201
		.999	322.3	9.1	12	343.4
Mini SCPC Approach	64 KBPS	.995	52.3	21.9	12	86.2
		.999	112.5	21.9	12	146.4

TABLE F-60. MONTHLY PAYOFF REQUIREMENT FOR 1982 C-BAND CPS SERVICES (UNSHARED EARTH STATIONS)

C I CPS
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.768 7 10.4

				COST PER MONTH						
	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	2380.0	350	366	400	720	506	11252	44378
LARGE	0.999	32000.0	2622.0	352	370	406	758	550	12297	40664
MEDIUM	0.995	6300.0	1046.5	370	407	481	1195	1048	24331	97765
MEDIUM	0.995	6300.0	1159.0	374	415	497	1207	1154	26084	100181
MEDIUM	0.995	6300.0	938.0	366	400	466	1105	946	21869	87719
MEDIUM	0.999	6300.0	1116.0	373	412	491	1252	1114	25708	104200
SMALL	0.995	1544.0	394.0	390	447	560	1656	1576	37065	
SMALL	0.999	1544.0	571.2	416	498	662	2252	2256	53472	
SMALL	0.995	1544.0	404.7	392	450	566	1692	1617	38056	
SMALL	0.999	1544.0	546.8	412	491	648	2170	2163	51213	
SMALL	0.995	1544.0	592.0	419	504	674	2321	2336	55398	
SMALL	0.999	1544.0	675.0	430	528	722	2600	2655	63003	
MINI	0.995	64.0	201.0	1031	1729	3125	16618	18675		
MINI	0.999	64.0	343.4	1526	2718	5103	28155	31060		
MINI	0.995	64.0	86.2	633	932	1531	7317	8045		
MINI	0.999	64.0	146.4	842	1350	2367	12194	13620		

TABLE F-61. MONTHLY PAYOFF REQUIREMENT FOR 1982 C-BAND CPS SERVICES (SHARED EARTH STATIONS)

C 1 CPS2

FILL FAC = 0.9 TARIFF FACTORS 1 1

CHANNEL UNIT COSTS = 4 4 4 4 0.760 7 10.4

COST PER MONTH

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	2388.0	1086	1536	2269	5320	664	21496	44390
LARGE	0.999	32000.0	2622.0	1000	1539	2276	5358	707	22541	40664
MEDIUM	0.995	6300.0	1046.5	1106	1577	2350	5794	1206	34575	97765
MEDIUM	0.99[illegible]	6300.0	1159.0	1110	1505	2366	5007	1312	37120	108181
MEDIUM	0.995	6300.0	930.0	1102	1569	2335	5705	1104	32113	07719
MEDIUM	0.999	6300.0	1116.0	1109	1502	2360	5051	1221	36152	104200

TABLE F-62. 1982 C-BAND CROSSOVER DISTANCE IN MILES (UNSHARED EARTH STATIONS)

C I CPS
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.760 7 10.4

				CROSSOVER DISTANCE							
	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	2300.0	1	1	1	1	369	270	102	57
LARGE	0.999	32000.0	2622.0	1	1	1	1	416	316	227	68
MEDIUM	0.995	6300.0	1046.5	4	1	1	1	946	846	741	199
MEDIUM	0.995	6300.0	1159.0	5	1	1	1	1099	959	850	234
MEDIUM	0.995	6300.0	938.0	2	1	1	1	838	730	636	172
MEDIUM	0.999	6300.0	1116.0	5	1	1	1	1026	916	809	220
SMALL	0.995	1544.0	394.0	11	1	1	1	1852	1661	1469	375
SMALL	0.999	1544.0	571.2	23	1	1	1	3067	2834	2622	620
SMALL	0.995	1544.0	404.7	12	1	1	1	1926	1732	1539	309
SMALL	0.999	1544.0	546.8	21	1	1	1	2899	2672	2463	587
SMALL	0.995	1544.0	592.0	24	1	1	5	3209	2971	2757	661
SMALL	0.999	1544.0	675.0	31	1	1	30	3778	3520	3297	795
MINI	0.995	64.0	201.0	620	1214	3017	4170	32306	31142	30450	
MINI	0.999	64.0	343.4	1237	2919	6427	8157	55931	53075	52798	
MINI	0.995	64.0	86.2	196	204	549	902	13405	12815	12434	
MINI	0.999	64.0	146.4	419	729	1710	2653	23358	22425	21802	

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TABLE F-63. 1982 C-BAND CROSSOVER DISTANCE IN MILES (SHARED SYSTEM)

C 1 CPS2 CROSSOVER DISTANCE
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.768 7 10.4

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	2308.0	670	927	1542	557	537	437	345	91
LARGE	0.999	32000.0	2622.0	680	930	1553	565	583	403	309	102
MEDIUM	0.995	6300.0	1046.5	700	970	1682	658	1191	1022	904	241
MEDIUM	0.995	6300.0	1159.0	704	970	1709	678	1380	1205	1021	277
MEDIUM	0.995	6300.0	938.0	696	962	1656	639	1009	905	790	207
MEDIUM	0.999	6300.0	1116.0	703	975	1699	670	1300	1135	971	263

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TABLE F-64. KU BAND ANNUAL RECURRING COST OF COMMON SYSTEMS
(in thousands of dollars)

E(S) Type	Capacity FDX	Availability	Earth Seg. Cost	Space Seg. Cost	NCC Cost	Total
Large BR = 60	32 FDX	.995	442	3424	12	3878
		.999	738	3424	12	4174
		.999	810	3424	12	424
Medium BR = 60	6.3 FDX	.995	442	6741	12	1128
		.999	738	6741	12	1212
		.999	810	6741	12	1496.1
Medium BR = 15 MBPS	6.3 FDX	.995	325	8990	12	1236
		.999	5945	8990	12	1505
		.999	681	8990	12	1592
Small BR = 15 MBS	1.5 MBS	.995	325	214	12	551
		.999	594.5	214	12	820
		.999	681	214	12	907
Small 8 MBPS	1.5 MBS	.995	368.5	241.0	12	627
	1.5 MBS	.999	480.2	241.0	12	733
		.999	544.2	241.0	12	797
Small SCPC	1.5 MBS	.995	197.5	401.25	12	611
	1.5 MBS	.999	324.3	401.25	12	737
		.999	346.86	401.25	12	760
Mini BR = 8 MBS	64 KBPS	.995	368.5	10.3	12	391
		.999	480.2	10.3	12	502
		.999	544.2	10.3	12	566
Mini SCPC	64 KBPS	.995	155.8	11.5	12	179
		.999	331.28	11.5	12	355
		.999	354.2	11.5	12	378

TABLE F-65. MONTHLY PAYOFF REQUIREMENT FOR 1982 KU-BAND CPS SERVICES (UNSHARED EARTH STATIONS)

KU 1 CPS
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.768 7 10.4

				COST PER MONTH						
	AVAIL	CAFAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	3078.0	360	387	441	762	782	17909	71559
LARGE	0.999	32000.0	4174.0	362	371	449	1010	837	19231	76955
LARGE	0.999	32000.0	4246.0	363	392	451	1021	850	19553	70268
MEDIUM	0.995	6300.0	1128.0	373	413	492	1262	1125	26161	105311
MEDIUM	0.999	6300.0	1424.0	384	434	534	1505	1403	32898	132717
MEDIUM	0.999	6300.0	1496.0	386	439	544	1565	1471	34531	137305
MEDIUM	0.995	6300.0	1236.0	377	421	500	1351	1227	28631	115311
MEDIUM	0.999	6300.0	1505.0	386	440	546	1572	1480	34736	140219
MEDIUM	0.999	6300.0	1592.0	389	446	558	1644	1561	36710	148274
SMALL	0.995	1544.0	551.0	413	492	651	2104	2179	51602	
SMALL	0.999	1544.0	820.5	451	570	806	3089	3213	76556	
SMALL	0.999	1544.0	907.5	464	595	856	3381	3547	84611	
SMALL	0.995	1544.0	621.0	423	512	691	2419	2447	58003	
SMALL	0.999	1544.0	733.0	439	544	755	2795	2877	68454	
SMALL	0.999	1544.0	797.0	448	563	792	3010	3123	74380	
SMALL	0.995	1544.0	611.0	421	509	685	2385	2409	57157	
SMALL	0.999	1544.0	737.6	439	546	758	2810	2895	68080	
SMALL	0.999	1544.0	760.2	443	552	771	2886	2982	70972	
MINI	0.995	64.0	391.0	1691	3049	5764	32012	36260		
MINI	0.999	64.0	502.5	2078	3823	7312	41045	46592		
MINI	0.999	64.0	566.5	2300	4267	8201	46230	52518		
MINI	0.995	64.0	179.0	955	1576	2819	14836	16638		
MINI	0.999	64.0	355.0	1566	2799	5264	29095	32934		
MINI	0.999	64.0	378.0	1646	2958	5583	30950	35064		

TABLE F-66. MONTHLY PAYOFF REQUIREMENTS FOR 1982 KU-BAND CPS SERVICES (SHARED EARTH STATIONS)

KU 1 CPS2
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.768 7 10.4

				COST PER MONTH						
	AVAIL	CAPAC	COST	2.4.	4.0	9.6	56	64	1544	6300
LARGE	0.995	32000.0	3078.0	1096	1557	2311	5561	940	20152	71559
LARGE	0.999	32000.0	4174.0	1090	1561	2319	5609	994	29475	76955
LARGE	0.999	32000.0	4246.0	1099	1562	2321	5621	1008	29797	78248
MEDIUM	0.995	6300.0	1128.0	1109	1582	2362	5861	1283	36424	105311
MEDIUM	0.999	6300.0	1424.0	1120	1603	2404	6105	1561	43141	132719
MEDIUM	0.999	6300.0	1496.0	1122	1608	2414	6164	1629	44775	139305
MEDIUM	0.995	6300.0	1236.0	1113	1590	2377	5950	1384	38875	115311
MEDIUM	0.999	6300.0	1505.0	1122	1609	2415	6171	1637	44979	140219
MEDIUM	0.999	6300.0	1592.0	1126	1615	2427	6243	1719	4695[illegible]	140274

TABLE F-67. 1982 KU-BAND CROSSOVER DISTANCE IN MILES (UNSHARED EARTH STATIONS)

KU 1 CPS
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.760 7 10.4

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	3878.0	1	1	1	1	663	563	467	129
LARGE	0.999	32000.0	4174.0	1	1	1	1	721	621	523	143
LARGE	0.999	32000.0	4246.0	1	1	1	1	736	636	537	147
MEDIUM	0.995	6300.0	1128.0	5	1	1	1	1047	928	820	224
MEDIUM	0.999	6300.0	1424.0	9	1	1	1	1544	1363	1176	317
MEDIUM	0.999	6300.0	1496.0	10	1	1	1	1665	1480	1291	340
MEDIUM	0.995	6300.0	1236.0	6	1	1	1	1228	1058	925	258
MEDIUM	0.999	6300.0	1505.0	10	1	1	1	1680	1494	1306	343
MEDIUM	0.999	6300.0	1592.0	11	1	1	1	1826	1636	1444	370
SMALL	0.995	1544.0	551.0	21	1	1	1	2928	2700	2490	596
SMALL	0.999	1544.0	820.5	44	1	1	90	4775	4483	4244	1028
SMALL	0.999	1544.0	907.5	52	7	1	145	5372	5059	4810	1168
SMALL	0.995	1544.0	621.0	26	1	1	12	3408	3163	2946	708
SMALL	0.999	1544.0	733.0	36	1	1	54	4176	3904	3674	888
SMALL	0.999	1544.0	797.0	42	1	1	88	4614	4328	4091	990
SMALL	0.995	1544.0	611.0	25	1	1	10	3339	3097	2881	692
SMALL	0.999	1544.0	737.6	37	1	1	55	4207	3935	3704	895
SMALL	0.999	1544.0	760.2	39	1	1	65	4362	4084	3851	931
MINI	0.995	64.0	391.0	1522	3489	7567	9487	63001	61474	60260	
MINI	0.999	64.0	502.5	2109	4824	10237	12602	82237	79274	77767	
MINI	0.999	64.0	566.5	2573	5590	11770	14390	92819	89491	87811	
MINI	0.995	64.0	179.0	539	970	2491	3564	28748	27630	26978	
MINI	0.999	64.0	355.0	1306	3058	6705	8481	57849	55727	54619	
MINI	0.999	64.0	378.0	1444	3333	7256	9123	61652	59399	58228	

TABLE F-68. 1982 KU-BAND CROSSOVER DISTANCE IN MILES (SHARED EARTH STATION)

KU 1 CPS2
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 4 4 4 4 0.760 7 10.4

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	3878.0	609	949	1613	609	831	731	629	163
LARGE	0.999	32000.0	4174.0	692	953	1627	619	809	789	606	177
LARGE	0.999	32000.0	4246.0	692	954	1631	621	903	803	699	181
MEDIUM	0.995	6300.0	1120.0	703	976	1702	672	1320	1155	903	267
MEDIUM	0.999	6300.0	1424.0	714	990	1774	724	1025	1635	1443	360
MEDIUM	0.999	6300.0	1496.0	717	1006	1791	737	1946	1751	1558	303
MEDIUM	0.995	6300.0	1236.0	707	984	1728	691	1507	1330	1144	301
MEDIUM	0.999	6300.0	1505.0	717	1007	1794	730	1961	1766	1572	386
MEDIUM	0.999	6300.0	1592.0	721	1018	1815	754	2107	1907	1711	413

TABLE F-69. TRENDS IN TRANSPONDER CONFIGURATIONS

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RX: Receiver, TX: Transmitter, D: Distributer, C: Combiner
TD: Time Domain, SD: Space Domain, DEM: Demodulator, MOD: Modulator

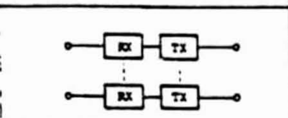
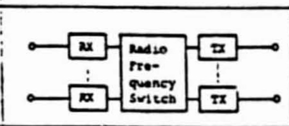
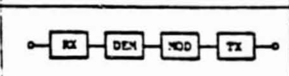
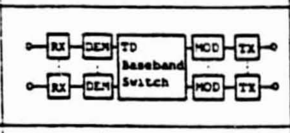
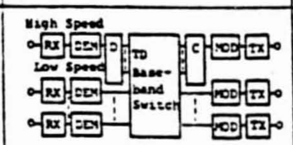
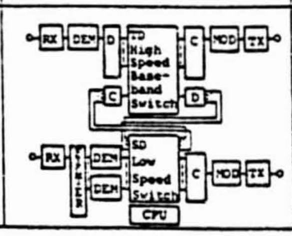
Case	Transponder configuration	Features & functions
I		Single beam/transponder. Connection between transponders is carried out at the earth station.
II		Multibeam. Connection between transponders is achieved by RF switch.
III		On board regeneration. Separation of the up and the down links.
IV		Multibeam. Time domain baseband switch.
V		Baseband signal is the same as low speed signal. Speed conversion. Time domain baseband channel switch.
VI		Connection between high speed signal and low speed signal. Speed conversion and on board regeneration. Proposed future transponder configuration.

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TABLE F-70. PROJECTED COST REDUCTION FACTORS FOR EARTH STATIONS

Cost Element	Cost Reduction Factor		
	1982	1990	2000
R F	1	0.78	0.54
TDMA Subsystem	1	0.27	.094
M&C Subsystem	1	0.27	.094

TABLE F-71. PROJECTED C BAND CPS EARTH STATION COSTS (IN THOUSANDS OF DOLLARS (1982 DOLLARS)

E(S) Type	Capacity	Approach	Availability	Year 1990 E(S) Cost	Year 1990 Installation	Year 1990 Total	Year 2000 Earth Station Cost	Year 2000 Installation	Year 2000 Total
Large	32 MBPS	60 MBPS	.995	289.20	115.65	405.0	184.50	73.8	258.30
		TDMA	.999	398.00	159.10	557.0	250.40	100.2	350.60
Medium	6.3 MBPS	15 MBPS	.995	108.00	43.16	151.0	68.20	27.3	95.50
		TDMA	.999	206.30	82.50	288.8	132.30	52.9	185.20
Small	1.5 MBPS	8 MBPS	.995	91.90	36.70	128.6	58.00	23.2	81.30
		TDMA	.999	171.60	68.60	240.2	110.20	44.1	154.20
Small	1.5 MBPS	SCPC	.995	50.10	20.00	70.1	33.60	13.4	47.00
			.999	107.80	43.20	151.0	72.50	29.0	101.50
Mini	1 V F	SCPC	.995	32.40	13.00	45.4	21.90	8.8	30.70
	64 KBPS	Digital	.999	70.32	28.10	98.5	47.60	19.0	66.60

TABLE F-72. PROJECTED KU BAND CPS EARTH STATION COSTS IN THOUSANDS OF DOLLARS (1982 DOLLARS)

				1990			2000		
E(S) Type	Capacity	Approach	Availability	E(S) Cost	Installation	Total	E(S) Cost	Installation	Total
Large	32 MBPS	60 MBPS TDMA	.995	213.2	85.3	298.4	131.1	52.5	183.6
			.999	363.3	145.3	503.5	225.7	90.3	316.0
			.999	412.4	165.0	577.3	259.8	104.0	363.7
Med/Small	6.3/1.5	15 MBPS TDMA	.995	179.8	71.9	251.7	116.3	46.5	162.8
			.999	311.0	124.3	435.3	204.8	81.9	286.7
			.999	369.7	147.9	517.5	245.4	98.2	343.6
Small/Mini	1.5 MBPS 64 KBPS	8 MBPS TDMA	.995	214.3	85.7	299.9	141.2	56.4	197.6
			.999	279.4	111.8	391.2	184.8	73.9	258.7
			.999	322.3	128.9	451.2	214.5	85.8	300.3
Small	1.5 MBPS	SCPC	.995	128.0	51.3	179.3	87.53	35.1	122.6
			.999	217.3	86.9	304.2	148.2	59.3	207.5
			.999	233.1	93.2	326.3	159.2	63.6	222.8
Mini	64 IVF	SCPS	.995	103.0	41.3	144.3	70.8	28.3	99.1
			.999	214.2	85.8	300	147.2	58.9	206.1
			.999	229.8	92.0	321.8	158.0	63.2	221.2

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TABLE F-73. C BAND ANNUAL RECURRING COST OF THE SYSTEM IN THOUSANDS OF DOLLARS FOR YEAR 1990

CAP FDX	Earth Station Type	Approach	Avail-ability	Earth Segment	Space Segment	NCC	Total
Large	32 FDX	60 MBPS	.995	332.1	1209	3.3	1544.4
		TDMA	.995	456.8	1209	3.3	3213.4
Medium	6.3 FDX	60 MBPS	.995	332.1	238.1	3.3	573.5
		TDMA	.999	456.8	238.1	3.3	698.2
Medium	1.3 FDX	15 MBPS	.995	123.82	714	3.3	841.2
		TDMA	.999	236.82	714	3.3	954.2
Small	1.544 FDX	15 MBPS	.995	123.82	170	3.3	297.12
		TDMA	.999	231.82	170	3.3	410.2
Small	1.544 FDX	8 MBPS	.995	105.5	213	3.3	321.8
		TDMA	.999	197.0	213	3.3	302.5
Small	1.544 FDX	SCPC	.995	57.5	486	3.3	546
			.999	123.9	486	3.3	613.2
Mini	.064 FDX	8 MBPS	.995	105.5	9.1	3.3	130.3
		TDMA	.999	197.0	9.1	3.3	209.4
Mini	.064 FDX	SCPC	.995	26.6	21.9	3.3	51.8
		Digital	.999	57.7	21.9	3.3	82.9

TABLE F-74. C BAND ANNUAL RECURRING COST OF THE SYSTEM IN THOUSANDS OF DOLLARS FOR YEAR 2000

CAP FDX	Earth Station Type	Approach	Avail-ability	Earth Segment	Space Segment	NCC	Total
Large	32 FDX	60 MBPS	.995	211.8	1209	1.2	1422.2
		TDMA	.999	287.4	1209	1.2	1497.7
Medium	6.3 MBPS	60 MBPS	.995	211.8	238.1	1.2	451.1
	FDX	TDMA	.999	287.5	238.1	1.2	239.3
Medium	6.3 MBPS	15 MBPS	.995	78.3	714	1.2	793.5
	FDX	TDMA	.999	151.9	714	1.2	837.1
Small	1.544	15 MBPS	.995	78.3	170	1.2	249.5
	FDX	TDMA	.999	151.9	170	1.2	323.1
Small	1.544	8 MBPS	.995	66.7	213	1.2	280.9
	FDX	TDMA	.999	126.5	213	1.2	340.7
Small	1.544	SCPC	.995	38.6	486	1.2	525.8
	FDX		.999	83.3	486	1.2	570.5
Mini	.064	8 MBPS	.995	66.7	9.1	1.2	77.0
	FDX	TDMA					
			.999	126.5	9.1	1.2	136.8
		SCPC	.995	25.2	21.9	1.2	48.3
			.999	54.6	21.9	1.2	77.7

TABLE F-75. KU BAND ANNUAL RECURRING COST OF THE SYSTEM IN THOUSANDS OF DOLLARS FOR YEAR 1990

CAP FDX	Earth Station Type	Approach	Availability	Earth Segment	Space Segment	NCC	Total
Large	32 FDX	60 MBPS TDMA	.995	244.7	1712	3.3	1960
			.999	417.0	1712	3.3	2132.3
			.999	473.4	1712	3.3	2188.7
Medium	6.3 FDX	60 MBPS TDMA	.995	244.7	337.1	3.3	585.1
			.999	417.0	337.1	3.3	757.4
			.999	473.4	337.1	3.3	813.8
Medium	6.3 FDX	15 MBPS TDMA	.995	206.4	674.1	3.3	883.8
			.999	357.0	674.1	3.3	1034.4
			.999	424.4	674.1	3.3	1101.8
Small	1.544 FDX	15 MBPS TDMA	.995	206.4	165.2	3.3	374.9
			.999	357.0	165.2	3.3	525.5
			.999	424.4	165.2	3.3	592.9
Small	1.544 FDX	8 MBPS TDMA	.995	245.9	185.9	3.3	435.1
			.999	320.8	185.9	3.3	510
			.999	370.0	185.9	3.3	559.2
	1.544 FDX	SCPC	.995	147.0	301.0	3.3	451.3
			.999	249.5	301.0	3.3	553.8
			.999	267.6	301.0	3.3	517.1
Mini	.064	8 MBPS TDMA	.995	245.9	7.9	3.3	257.2
			.999	320.8	7.9	3.3	332.1
			.999	370.0	7.0	3.3	381.3
		SCPC	.995	118.3	8.6	3.3	130.2
			.999	246.0	8.6	3.3	257.9
			.999	263.8	8.6	3.3	275.8

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TABLE F-76. KU BAND ANNUAL RECURRING COST OF THE SYSTEM IN THOUSANDS OF DOLLARS FOR YEAR 2000

CAP FDX	Earth Station Type	Approach	Avail-ability	Earth Segment	Space Segment	NCC	Total
Large	32 FDX	60 MBPS TDMA	.995	150.6	806.6	1.2	958.4
			.999	259.2	806.6	1.2	1067.0
			.999	298.3	806.6	1.2	1106.1
Medium	6.3 FDX	60 MBPS TDMA	.995	150.6	158.8	1.2	310.6
			.999	259.2	158.8	1.2	419.2
			.999	298.3	158.8	1.2	458.3
Medium	6.3 FDX	15 MBPS TDMA	.995	133.5	476.4	1.2	611.1
			.999	235.1	476.4	1.2	712.7
			.999	281.8	476.4	1.2	759.4
Small	1.544 FDX	15 MBPS TDMA	.995	133.5	119.1	1.2	253.8
			.999	235.1	119.1	1.2	355.4
			.999	281.8	119.1	1.2	402.1
Small	1.544 FDX	8 MBPS TDMA	.995	162.1	127.8	1.2	291.1
			.999	212.2	127.8	1.2	341.2
			.999	246.3	127.8	1.2	375.3
	1.544 FDX	SCPC	.995	100.5	212.7	1.2	314.4
			.999	170.2	212.7	1.2	384.1
			.999	182.7	212.7	1.2	396.6
Mini	.064	8 MBPS TDMA	.995	162.1	5.5	1.2	168.8
			.999	212.2	5.5	1.2	218.9
			.999	246.3	5.5	1.2	253.0
		SCPC	.995	81.3	6.1	1.2	88.6
			.999	169.0	6.1	1.2	176.3
			.999	181.4	6.1	1.2	188.7

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TABLE F-77. KA BAND (1990) ANNUAL PAYOFF REQUIREMENT

CAP FDX	Earth Station Type	Approach	Earth Segment Cost	Space Segment Cost	NCC	Total
32 MBPS	Large	TDMA	270.6K	4.533M	20K	4824K
				3.2M		3480K
				2.0M		2290.6K
32 MBPS	Large	FDMA	794.6K		20K	
			680.6K			
	Delete					
6.3 MBPS	Medium	TDMA	191.1	892.5		1103.6
				627.9	20K	839.0
				393.75	20K	604.85
6.3 MBPS	Medium	FDMA	386.2		20K	
			294.4			
		Delete				
1.544	Small	TDMA	171	218.73K	20	409.73
				153.88K		344.9
				96.5		287.5
1.544	Small	FDMA	269.8		20	
			135.3		20	
		Delete			20	
					20	
64 KBPS	Mini	TDMA	89.4K	9.1	20	118.5
				6.38		115.8
				4.0		113.4
64 KBPS	Mini	FDMA	77.9		20	103.5
			69.7		20	95.3
		Delete				101.5
						93.3

TABLE F-78. KA BAND CPS SYSTEM COSTS ANNUAL PAYOFF REQUIREMENT (2000)

CAP FDX	Earth Station Type	Approach	Earth Segment Cost	Space Segment Cost	NCC	Total
32	Large	TDMA	199.5	2000K	7	2206.5
6.3	Medium	TDMA	141	393.75	7	541.15
1.544	Small	TDMA	126	96.5	7	229.5
64 KB	Mini	TDMA	66	4	7	77K

TABLE F-79. MONTHLY PAY OFF REQUIREMENT FOR 1990
C-BAND CPS SERVICES (UNSHARED EARTH STATION)

C 3 CPS
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

COST PER MONTH

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	1544.4	107	117	139	346	311	7966	28153
LARGE	0.999	32000.0	3213.4	118	140	185	617	620	14523	50578
MEDIUM	0.995	6300.0	573.5	116	136	177	568	564	13181	53102
MEDIUM	0.999	6300.0	698.2	120	145	194	670	682	16011	64648
MEDIUM	0.995	6300.0	841.2	126	155	215	708	816	19256	77889
MEDIUM	0.999	6300.0	954.2	129	163	230	881	923	21820	88352
SMALL	0.995	1544.0	297.1	139	181	267	1094	1165	27678	
SMALL	0.999	1544.0	410.2	155	214	332	1473	1579	38148	
SMALL	0.995	1544.0	321.8	142	188	281	1177	1260	29963	
SMALL	0.999	1544.0	302.5	139	183	270	1112	1106	28176	
SMALL	0.995	1544.0	546.0	174	253	410	1929	2121	50722	
SMALL	0.999	1544.0	613.2	184	272	449	2155	2370	56944	
MINI	0.995	64.0	130.3	548	1001	1906	10653	12090		
MINI	0.999	64.0	209.4	823	1550	3004	17061	19414		
MINI	0.995	64.0	51.8	276	456	815	4293	4821		
MINI	0.999	64.0	82.4	382	668	1240	6772	7655		

TABLE F-80. MONTHLY PAY OFF REQUIREMENT IN $ FOR YEAR 2000
C-BAND CPS SERVICES (UNSHARED EARTH STATIONS)

C 4 CPS
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

COST PER MONTH

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	1422.2	39	49	69	260	270	6409	25926
LARGE	0.999	32000.0	1497.7	40	50	71	272	284	6746	27302
MEDIUM	0.995	6300.0	451.1	45	61	93	400	431	10292	41769
MEDIUM	0.999	6300.0	239.3	38	46	63	226	232	5485	22157
MEDIUM	0.995	6300.0	793.5	57	85	141	682	753	10062	73472
MEDIUM	0.999	6300.0	837.1	59	88	147	718	794	19051	77509

TABLE F-81. MONTHLY PAYOFF REQUIREMENT IN $ FOR YEAR 1990
C-BAND CPS SERVICES (SHARED EARTH STATIONS)

C 3 CPS2 COST PER MONTH
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	1544.4	726	1083	1665	4177	467	10179	28153
LARGE	0.999	32000.0	3213.4	737	1106	1711	4447	776	17636	50578
MEDIUM	0.995	6300.0	573.5	735	1102	1703	4399	721	16294	53102
MEDIUM	0.999	6300.0	698.2	740	1111	1720	4501	838	19124	64648
MEDIUM	0.995	6300.0	841.2	745	1121	1740	4619	972	22369	77889
MEDIUM	0.999	6300.0	954.2	749	1129	1756	4712	1079	24933	88352

TABLE F-82. MONTHLY PAYOFF REQUIREMENT IN $ FOR YEAR 2000
(C-BAND CPS SERVICES) SHARED EARTH STATION

C 4 CPS2 COST PER MONTH
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	1422.2	588	893	1380	3630	426	9522	25926
LARGE	0.999	32000.0	1497.7	589	894	1391	3642	440	9859	27302
MEDIUM	0.995	6300.0	451.1	594	905	1413	3771	587	13405	41769
MEDIUM	0.999	6300.0	239.3	587	890	1383	3596	387	8598	22157
MEDIUM	0.995	6300.0	793.5	606	929	1461	4052	909	21175	73472
MEDIUM	0.999	6300.0	837.1	608	932	1467	4088	950	22164	77509

TABLE F-83. 1990 C-BAND CROSSOVER DISTANCE IN MILES UNSHARED EARTH STATIONS

C 3 CPS
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	1544.4	1	1	1	1	170	87	51	21
LARGE	0.999	32000.0	3213.4	1	1	1	1	544	430	327	112
MEDIUM	0.995	6300.0	573.5	1	1	1	1	477	363	262	96
MEDIUM	0.999	6300.0	698.2	1	1	1	1	618	505	399	131
MEDIUM	0.995	6300.0	841.2	1	1	1	1	701	667	557	171
MEDIUM	0.999	6300.0	954.2	1	1	1	1	910	796	681	202
SMALL	0.995	1544.0	297.1	1	1	1	1	1135	1090	966	261
SMALL	0.999	1544.0	410.2	1	1	1	1	2016	1796	1578	426
SMALL	0.995	1544.0	321.8	1	1	1	1	1327	1132	1077	297
SMALL	0.999	1544.0	302.5	1	1	1	1	1177	1114	990	268
SMALL	0.995	1544.0	546.0	1	1	1	4	3073	2818	2582	603
SMALL	0.999	1544.0	613.2	1	1	1	24	3597	3323	3078	726
MINI	0.995	64.0	130.3	177	515	1239	2424	23303	22350	21783	
MINI	0.999	64.0	209.4	509	1091	3391	4935	38165	36700	35889	
MINI	0.995	64.0	51.8	1	1	26	463	8554	8109	7783	
MINI	0.999	64.0	82.4	38	112	466	1063	14303	13660	13240	

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TABLE F-84. 2000 C-BAND CROSSOVER DISTANCE IN MILES
UNSHARED EARTH STATION

C 4 CPS

CROSSOVER DISTANCE

FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82

CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	1422.2	1	1	1	1	122	65	40	18
LARGE	0.999	32000.0	1497.7	1	1	1	1	140	74	41	23
MEDIUM	0.995	6300.0	451.1	1	1	1	1	331	209	106	70
MEDIUM	0.999	6300.0	239.3	1	1	1	1	101	41	29	6
MEDIUM	0.995	6300.0	793.5	1	1	1	1	749	627	511	172
MEDIUM	0.999	6300.0	837.1	1	1	1	1	802	680	562	185
SMALL	0.995	1544.0	249.5	1	1	1	1	1023	901	776	240
SMALL	0.999	1544.0	323.1	1	1	1	1	1322	1113	1131	310
SMALL	0.995	1544.0	280.9	1	1	1	1	1179	1057	928	244
SMALL	0.999	1544.0	340.7	1	1	1	1	1469	1255	1031	338
SMALL	0.995	1544.0	525.8	1	1	1	13	3016	2749	2499	577
SMALL	0.999	1544.0	570.5	1	1	1	26	3390	3110	2854	665
MINI	0.995	64.0	77.0	13	92	442	1062	14148	13497	13065	
MINI	0.999	64.0	136.8	171	596	1522	2817	26206	25139	24510	
MINI	0.995	64.0	48.3	1	1	20	459	8361	7909	7572	
MINI	0.999	64.0	77.7	15	95	455	1077	14287	13633	13199	

TABLE F-85. 1990 C-BAND CROSSOVER DISTANCE IN MILES
SHARED EARTH STATIONS

C 3 CPS2 CROSSOVER DISTANCE
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	1544.4	392	614	979	435	359	246	148	59
LARGE	0.999	32000.0	3213.4	406	642	1035	501	733	619	510	151
MEDIUM	0.995	6300.0	573.5	403	637	1025	489	665	552	445	134
MEDIUM	0.999	6300.0	698.2	409	648	1046	514	807	694	502	169
MEDIUM	0.995	6300.0	841.2	415	660	1070	542	970	856	740	209
MEDIUM	0.999	6300.0	954.2	419	670	1090	565	1098	985	864	217

TABLE F-86. 2000 C-BAND CROSSOVER DISTANCE IN MILES
SHARED EARTH STATION

C 4 CPS2
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	1422.2	280	484	818	377	324	202	104	60
LARGE	0.999	32000.0	1497.7	280	485	821	381	342	220	117	64
MEDIUM	0.995	6300.0	451.1	287	499	849	414	533	411	301	111
MEDIUM	0.999	6300.0	239.3	278	480	811	369	274	153	84	47
MEDIUM	0.995	6300.0	793.5	303	531	912	487	951	829	706	213
MEDIUM	0.999	6300.0	837.1	305	535	920	496	1004	882	758	227

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TABLE F-87. 1990 MONTHLY PAYOFF REQUIREMENT FOR KU BAND CPS SERVICES (UNSHARED EARTH STATIONS)

KU 2 CPS COST PER MONTH
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	1960.0	109	123	150	413	388	8923	35729
LARGE	0.999	32000.0	2132.3	111	125	155	441	420	9693	38870
LARGE	0.999	32000.0	2188.7	111	126	157	450	430	9945	39878
MEDIUM	0.995	6300.0	585.1	116	137	178	577	575	13444	54176
MEDIUM	0.999	6300.0	757.4	123	149	203	719	737	17354	70130
MEDIUM	0.999	6300.0	813.8	125	153	211	766	790	18634	75352
MEDIUM	0.995	6300.0	883.8	127	158	221	823	856	20222	81833
MEDIUM	0.999	6300.0	1034.4	132	169	242	947	998	23640	95778
MEDIUM	0.999	6300.0	1101.8	135	174	251	1003	1061	25169	102019
SMALL	0.995	1544.0	374.9	150	204	312	1355	1464	34880	
SMALL	0.999	1544.0	525.5	171	247	398	1861	2042	48824	
SMALL	0.999	1544.0	592.9	181	267	437	2087	2301	55065	
SMALL	0.995	1544.0	435.1	158	221	346	1557	1675	40454	
SMALL	0.999	1544.0	510.0	169	243	389	1809	1982	47389	
SMALL	0.999	1544.0	559.2	176	257	418	1974	2171	51944	
SMALL	0.995	1544.0	451.3	161	226	356	1611	1757	41954	
SMALL	0.999	1544.0	553.8	176	255	415	1956	2151	51444	
SMALL	0.999	1544.0	517.1	170	245	394	1832	2010	48046	
MINI	0.995	64.0	257.2	989	1882	3668	20934	23840		
MINI	0.999	64.0	332.1	1249	2402	4708	27002	30775		
MINI	0.999	64.0	381.3	1420	2744	5392	30988	35331		
MINI	0.995	64.0	130.2	548	1000	1904	10644	12081		
MINI	0.999	64.0	257.9	991	1887	3678	20991	23905		
MINI	0.999	64.0	275.8	1053	2011	3926	22441	25562		

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TABLE F-88. 1990 CROSSOVER DISTANCE IN MILES
KU BAND CPS SERVICES (UNSARED EARTH STATIONS)

KU 2 CPS CROSSOVER DISTANCE
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	1960.0	1	1	1	1	263	150	80	44
LARGE	0.999	32000.0	2132.3	1	1	1	1	302	188	99	53
LARGE	0.999	32000.0	2188.7	1	1	1	1	314	201	105	56
MEDIUM	0.995	6300.0	585.1	1	1	1	1	490	376	275	99
MEDIUM	0.999	6300.0	757.4	1	1	1	1	686	572	464	147
MEDIUM	0.999	6300.0	813.8	1	1	1	1	750	636	527	163
MEDIUM	0.995	6300.0	883.8	1	1	1	1	829	716	604	183
MEDIUM	0.999	6300.0	1034.4	1	1	1	1	1001	887	770	225
MEDIUM	0.999	6300.0	1101.8	1	1	1	1	1077	964	844	221
SMALL	0.995	1544.0	374.9	1	1	1	1	1741	1531	1317	374
SMALL	0.999	1544.0	525.5	1	1	1	1	2913	2664	2430	566
SMALL	0.999	1544.0	592.9	1	1	1	16	3438	3170	2928	689
SMALL	0.995	1544.0	435.1	1	1	1	1	2209	1984	1762	462
SMALL	0.999	1544.0	510.0	1	1	1	1	2793	2547	2316	538
SMALL	0.999	1544.0	559.2	1	1	1	8	3176	2917	2679	628
SMALL	0.995	1544.0	451.3	1	1	1	1	2336	2106	1882	486
SMALL	0.999	1544.0	553.8	1	1	1	7	3134	2876	2639	618
SMALL	0.999	1544.0	517.1	1	1	1	1	2848	2600	2368	551
MINI	0.995	64.0	257.2	710	1741	4692	6452	47146	45371	44414	
MINI	0.999	64.0	332.1	1024	2760	6730	8830	61219	58959	57771	
MINI	0.999	64.0	381.3	1175	3430	8069	10392	70464	67884	66545	
MINI	0.995	64.0	130.2	177	514	1236	2420	23284	22332	21765	
MINI	0.999	64.0	257.9	713	1751	4711	6475	47278	45498	44539	
MINI	0.999	64.0	275.8	788	1994	5198	7043	50641	48745	47731	

TABLE F-89. 1990 MONTHLY PAYOFF REQUIREMENT FOR KU BAND CPS SERVICES (SHARED EARTH STATION)

KU 2 CPS2
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

				COST PER MONTH						
	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	1960.0	729	1089	1676	4244	544	12036	35729
LARGE	0.999	32000.0	2132.3	730	1091	1681	4272	576	12806	38870
LARGE	0.999	32000.0	2188.7	730	1092	1682	4281	587	13058	39898
MEDIUM	0.995	6300.0	585.1	736	1103	1704	4408	732	16557	54176
MEDIUM	0.999	6300.0	757.4	742	1115	1729	4550	894	20467	70130
MEDIUM	0.999	6300.0	813.8	744	1119	1736	4596	947	21747	75352
MEDIUM	0.995	6300.0	883.8	746	1124	1746	4654	1013	23335	81833
MEDIUM	0.999	6300.0	1034.4	751	1135	1768	4778	1154	26753	95770
MEDIUM	0.999	6300.0	1101.8	754	1139	1777	4833	1218	28282	102017

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TABLE F-90. 1990 CROSSOVER DISTANCE IN MILES
KU BAND CPS SERVICES (SHARED EARTH STATIONS)

KU 2 CPS2
FILL FAC = 0.9 TARIFF FACTORS 0.8 0.88
CHANNEL UNIT COSTS = 1.15 1.15 1.15 1.15 0.3 2 0

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	1960.0	395	621	993	452	452	339	238	82
LARGE	0.999	32000.0	2132.3	397	624	998	458	491	377	275	91
LARGE	0.999	32000.0	2188.7	397	625	1000	461	503	390	288	94
MEDIUM	0.995	6300.0	585.1	404	638	1027	471	679	565	458	138
MEDIUM	0.999	6300.0	757.4	411	653	1056	526	875	761	647	186
MEDIUM	0.999	6300.0	813.8	413	658	1066	537	939	825	710	201
MEDIUM	0.995	6300.0	883.8	416	664	1078	551	1018	905	787	221
MEDIUM	0.999	6300.0	1034.4	423	677	1103	581	1112	1076	953	246
MEDIUM	0.999	6300.0	1101.8	426	682	1115	594	1241	1049	1027	270

TABLE F-91. 2000 MONTHLY PAYOFF REQUIREMENT
KU BAND CPS SERVICES (UNSHARED EARTH STATION)

KU 3 CPS
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

COST PER MONTH

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	958.4	36	42	56	184	184	4337	17471
LARGE	0.999	32000.0	1067.0	37	44	59	202	204	4822	19451
LARGE	0.999	32000.0	1106.1	37	45	60	209	211	4997	20163
MEDIUM	0.995	6300.0	310.6	40	51	73	285	299	7103	28759
MEDIUM	0.999	6300.0	419.2	44	59	88	374	401	9568	38815
MEDIUM	0.999	6300.0	458.3	45	61	94	406	438	10455	42435
MEDIUM	0.995	6300.0	611.1	51	72	115	532	581	13922	56583
MEDIUM	0.999	6300.0	712.7	54	79	130	616	677	16228	65991
MEDIUM	0.999	6300.0	759.4	56	83	136	654	721	17288	70315
SMALL	0.995	1544.0	253.8	66	102	175	881	981	23555	
SMALL	0.999	1544.0	355.4	80	131	234	1223	1371	32962	
SMALL	0.999	1544.0	402.1	87	145	261	1380	1550	37286	
SMALL	0.995	1544.0	291.1	71	113	197	1007	1124	27009	
SMALL	0.999	1544.0	341.2	78	127	226	1175	1316	31648	
SMALL	0.999	1544.0	375.3	83	137	245	1290	1447	34805	
SMALL	0.995	1544.0	314.4	74	120	210	1085	1213	29166	
SMALL	0.999	1544.0	384.1	84	140	250	1319	1481	35620	
SMALL	0.999	1544.0	396.6	86	143	257	1361	1529	36777	
MINI	0.995	64.0	168.8	615	1201	2374	13705	15636		
MINI	0.999	64.0	218.9	789	1549	3069	17764	20275		
MINI	0.999	64.0	253.0	908	1786	3543	20527	23433		
MINI	0.995	64.0	88.6	337	644	1260	7207	8210		
MINI	0.999	64.0	176.3	641	1253	2478	14313	16331		
MINI	0.999	64.0	188.7	684	1340	2650	15317	17479		

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TABLE F-92. 2000 CROSSOVER DISTANCE IN MILES
KU BAND CPS SERVICES (UNSHARED EARTH STATION)

KU 3 CPS
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	958.4	1	1	1	1	65	27	19	1
LARGE	0.999	32000.0	1067.0	1	1	1	1	80	33	24	1
LARGE	0.999	32000.0	1106.1	1	1	1	1	85	36	25	1
MEDIUM	0.995	6300.0	310.6	1	1	1	1	160	83	47	28
MEDIUM	0.999	6300.0	419.2	1	1	1	1	292	170	89	60
MEDIUM	0.999	6300.0	458.3	1	1	1	1	340	218	114	72
MEDIUM	0.995	6300.0	611.1	1	1	1	1	526	404	295	118
MEDIUM	0.999	6300.0	712.7	1	1	1	1	650	528	415	140
MEDIUM	0.999	6300.0	759.4	1	1	1	1	707	585	470	162
SMALL	0.995	1544.0	253.8	1	1	1	1	1044	922	797	202
SMALL	0.999	1544.0	355.4	1	1	1	1	1592	1374	1147	361
SMALL	0.999	1544.0	402.1	1	1	1	1	1982	1751	1518	434
SMALL	0.995	1544.0	291.1	1	1	1	1	1054	1108	977	260
SMALL	0.999	1544.0	341.2	1	1	1	1	1473	1259	1035	338
SMALL	0.999	1544.0	375.3	1	1	1	1	1758	1535	1305	392
SMALL	0.995	1544.0	314.4	1	1	1	1	1249	1043	1089	296
SMALL	0.999	1544.0	384.1	1	1	1	1	1832	1606	1375	406
SMALL	0.999	1544.0	396.6	1	1	1	1	1936	1706	1474	425
MINI	0.995	64.0	168.8	315	884	2456	3908	32658	31369	30634	
MINI	0.999	64.0	218.9	541	1224	3919	5615	42760	41123	[illegible]0222	
MINI	0.999	64.0	253.0	694	1721	4915	6776	49636	47761	46749	
MINI	0.995	64.0	88.6	32	162	651	1175	16437	15755	15285	
MINI	0.999	64.0	176.3	349	952	2675	4163	34170	32829	32069	
MINI	0.[illegible]79	64.0	188.7	405	1063	3037	4586	36671	35243	34443	

TABLE F-93. 2000 MONTHLY PAYOFF REQUIREMENT
KU BAND CPS SERVICES (SHARED EARTH STATION)

KU 3 CPS2

FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82

CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

				COST PER MONTH						
	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.995	32000.0	958.4	585	886	1376	3555	340	7450	17471
LARGE	0.999	32000.0	1067.0	586	888	1379	3572	360	7935	19451
LARGE	0.999	32000.0	1106.1	586	888	1380	3579	367	8110	20163
MEDIUM	0.995	6300.0	310.6	589	895	1393	3655	454	10216	28759
MEDIUM	0.999	6300.0	419.2	593	903	1408	3744	557	12681	38815
MEDIUM	0.999	6300.0	458.3	594	905	1414	3777	593	13568	42435
MEDIUM	0.995	6300.0	611.1	600	916	1435	3902	737	17035	56553
MEDIUM	0.999	6300.0	712.7	603	923	1449	3986	833	19341	65991
MEDIUM	0.999	6300.0	759.4	605	927	1456	4024	877	20401	70315

TABLE F-94. 2000 CROSSOVER DISTANCE IN MILES
KU BAND CPS SERVICES (SHARED EARTH STATION)

KU 3 CPS2
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.995	32000.0	958.4	275	475	801	358	213	109	64	32
LARGE	0.999	32000.0	1067.0	276	477	805	362	239	117	70	39
LARGE	0.999	32000.0	1106.1	277	478	807	364	248	126	74	41
MEDIUM	0.995	6300.0	310.6	281	486	824	384	361	240	135	67
MEDIUM	0.999	6300.0	419.2	286	496	843	407	494	372	264	101
MEDIUM	0.999	6300.0	458.3	288	500	851	415	542	420	310	113
MEDIUM	0.995	6300.0	611.1	295	514	879	448	728	606	491	159
MEDIUM	0.999	6300.0	712.7	299	523	897	470	852	730	611	189
MEDIUM	0.999	6300.0	759.4	302	527	906	482	909	787	666	203

TABLE F-95. 1990 MONTHLY PAYOFF REQUIREMENT KA BAND CPS SERVICES (UNSHARED EARTH STATIONS)

KA 3 CPS

FILL FAC = 0.9 TARIFF FACTORS 1 1

CHANNEL UNIT COSTS = 1 1 1 1 0.2 1.6 2.5

COST PER MONTH

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.999	32000.0	2640.6	102	120	157	511	506	11930	48344
LARGE	0.999	32000.0	1610.6	95	106	128	344	315	7329	29560
LARGE	0.999	32000.0	3587.0	108	133	183	665	681	16159	65596
LARGE	0.999	32000.0	2648.6	102	120	157	513	507	11966	48490
LARGE	0.999	32000.0	2534.6	101	119	154	494	486	11457	46412
LARGE	0.999	32000.0	3473.6	107	132	180	646	660	15652	63529
MEDIUM	0.999	6300.0	507.2	101	119	155	501	494	11643	47171
MEDIUM	0.999	6300.0	652.1	106	129	175	620	630	14931	60588
MEDIUM	0.999	6300.0	952.2	117	151	218	867	912	21741	88375
MEDIUM	0.999	6300.0	860.4	114	144	205	791	826	19658	79875
MEDIUM	0.999	6300.0	767.3	110	137	192	715	738	17545	71255
MEDIUM	0.999	6300.0	675.6	107	131	179	639	652	15464	62764
SMALL	0.999	1544.0	299.1	126	169	256	1088	1165	27828	
SMALL	0.999	1544.0	263.6	121	159	235	969	1028	24541	
SMALL	0.999	1544.0	423.6	144	205	327	1506	1642	39356	
SMALL	0.999	1544.0	289.1	125	167	250	1054	1126	26902	
SMALL	0.999	1544.0	378.3	138	192	301	1354	1469	35161	
SMALL	0.999	1544.0	243.8	118	154	224	902	952	22707	
MINI	0.999	64.0	113.9	479	874	1665	9311	10563		
MINI	0.999	64.0	112.4	474	864	1644	9190	10424		
MINI	0.999	64.0	103.5	443	802	1521	8469	9600		
MINI	0.999	64.0	95.3	414	745	1407	7804	8841		
MINI	0.999	64.0	101.5	436	788	1493	8307	9415		
MINI	0.999	64.0	93.3	407	731	1379	7642	8656		

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TABLE F-96. 1990 CROSSOVER DISTANCE IN MILES
KA BAND CPS SERVICES (UNSHARED EARTH STATION)

KA 3 CPS CROSSOVER DISTANCE
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 1 1 1 1 0.2 1.6 2.5

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.999	32000.0	2640.6	1	1	1	1	369	269	182	64
LARGE	0.999	32000.0	1610.6	1	1	1	1	166	84	51	14
LARGE	0.999	32000.0	3587.0	1	1	1	1	555	455	362	110
LARGE	0.999	32000.0	2648.6	1	1	1	1	370	271	183	65
LARGE	0.999	32000.0	2534.6	1	1	1	1	348	248	162	59
LARGE	0.999	32000.0	3473.6	1	1	1	1	533	433	341	105
MEDIUM	0.999	6300.0	507.2	1	1	1	1	356	256	169	61
MEDIUM	0.999	6300.0	652.1	1	1	1	1	501	401	310	97
MEDIUM	0.999	6300.0	952.2	1	1	1	1	801	702	601	171
MEDIUM	0.999	6300.0	860.4	1	1	1	1	710	610	512	148
MEDIUM	0.999	6300.0	767.3	1	1	1	1	616	517	422	125
MEDIUM	0.999	6300.0	675.6	1	1	1	1	525	425	333	103
SMALL	0.999	1544.0	299.1	1	1	1	1	1117	970	861	247
SMALL	0.999	1544.0	263.6	1	1	1	1	925	825	721	201
SMALL	0.999	1544.0	423.6	1	1	1	1	1971	1775	1581	407
SMALL	0.999	1544.0	289.1	1	1	1	1	1049	929	822	234
SMALL	0.999	1544.0	378.3	1	1	1	1	1660	1475	1287	348
SMALL	0.999	1544.0	243.8	1	1	1	1	844	744	642	181
MINI	0.999	64.0	113.9	61	223	692	1659	17900	17155	16701	
MINI	0.999	64.0	112.4	58	212	670	1617	17652	16916	16466	
MINI	0.999	64.0	103.5	39	146	538	1368	16180	15495	15069	
MINI	0.999	64.0	95.3	22	91	417	1139	14825	14186	13782	
MINI	0.999	64.0	101.5	34	131	509	1312	15850	15176	14755	
MINI	0.999	64.0	93.3	19	83	387	1083	14494	13867	13468	

TABLE F-97. 1990 MONTHLY PAYOFF REQUIREMENT KA BAND CPS SERVICES (SHARED EARTH STATION)

KA 3 CPS2
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 1 1 1 1 0.2 1.6 2.5

COST PER MONTH

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.999	32000.0	2640.6	838	1289	2026	5111	663	15043	48344
LARGE	0.999	32000.0	1610.6	831	1275	1998	4944	472	10442	29568
LARGE	0.999	32000.0	3587.0	844	1303	2052	5264	838	19272	65596
LARGE	0.999	32000.0	2648.6	838	1290	2026	5112	665	15079	48490
LARGE	0.999	32000.0	2534.6	837	1288	2023	5093	644	14570	46412
LARGE	0.999	32000.0	3473.6	844	1301	2049	5246	817	18765	63529
MEDIUM	0.999	6300.0	507.2	837	1289	2024	5100	651	14756	47171
MEDIUM	0.999	6300.0	652.1	842	1299	2045	5219	788	18044	60588
MEDIUM	0.999	6300.0	952.2	853	1320	2087	5466	1070	24854	88375
MEDIUM	0.999	6300.0	860.4	850	1314	2074	5391	983	22771	79875
MEDIUM	0.999	6300.0	767.3	846	1307	2061	5314	896	20658	71255
MEDIUM	0.999	6300.0	675.6	843	1300	2048	5239	810	18577	62764

TABLE F-98. 1990 CROSSOVER DISTANCE IN MILES KA BAND CPS SERVICES (SHARED EARTH STATION)

KA 3 CPS2 CROSSOVER DISTANCE
FILL FAC = 0.9 TARIFF FACTORS 1 1
CHANNEL UNIT COSTS = 1 1 1 1 0.2 1.6 2.5

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.999	32000.0	2640.6	414	664	1123	513	536	437	344	98
LARGE	0.999	32000.0	1610.6	407	649	1074	477	333	234	147	48
LARGE	0.999	32000.0	3587.0	421	678	1168	545	723	623	525	144
LARGE	0.999	32000.0	2648.6	414	665	1123	513	538	438	346	98
LARGE	0.999	32000.0	2534.6	414	663	1118	509	516	416	324	93
LARGE	0.999	32000.0	3473.6	421	677	1163	541	701	601	503	138
MEDIUM	0.999	6300.0	507.2	414	663	1120	511	524	424	332	95
MEDIUM	0.999	6300.0	652.1	419	674	1155	536	669	569	472	131
MEDIUM	0.999	6300.0	952.2	431	697	1228	588	969	869	763	206
MEDIUM	0.999	6300.0	860.4	427	690	1206	572	877	777	674	182
MEDIUM	0.979	6300.0	767.3	424	683	1183	556	784	684	584	159
MEDIUM	0.999	6300.0	675.6	420	676	1161	540	692	592	495	136

TABLE F-99. 2000 MONTHLY PAYOFF REQUIREMENT KA BAND CPS SERVICES (UNSHARED EARTH STATIONS)

KA 4 CPS

FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82

CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

				COST PER MONTH						
	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.999	32000.0	1072.8	37	44	59	203	205	4840	19556
MEDIUM	0.999	6300.0	329.0	41	52	76	300	316	7521	30463
SMALL	0.999	1544.0	187.2	56	83	137	658	725	17380	
MINI	0.999	64.0	88.0	335	640	1251	7159	8155		

TABLE F-100. 2000 CROSSOVER DISTANCE IN MILES
KA BAND CPS SERVICES (UNSHARED EARTH STATION)

KA 4 CPS
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

CROSSOVER DISTANCE

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.999	32000.0	1072.8	1	1	1	1	81	33	24	1
MEDIUM	0.999	6300.0	329.0	1	1	1	1	102	94	54	33
SMALL	0.999	1544.0	187.2	1	1	1	1	713	591	476	163
MINI	0.999	64.0	88.0	30	156	640	1155	16366	15630	15170	

TABLE F-101. 2000 MONTHLY PAYOFF REQUIREMENT
KA BAND CPS SERVICES (SHARED EARTH STATION)

```
KA 4        CPS2                                             COST PER MONTH
FILL FAC = 0.9        TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0
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	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	1544	6300
LARGE	0.999	32000.0	1072.8	586	888	1379	3573	361	7961	19556
MEDIUM	0.999	6300.0	329.0	590	896	1395	3670	472	10634	30463

TABLE F-102. 2000 CROSSOVER DISTANCE IN MILES
KA BAND CPS SERVICES (SHARED EARTH STATION)

KA 4 CPS2 CROSSOVER DISTANCE
FILL FAC = 0.9 TARIFF FACTORS 0.68 0.82
CHANNEL UNIT COSTS = 0.35 0.35 0.35 0.35 0.08 0.66 0

	AVAIL	CAPAC	COST	2.4	4.8	9.6	56	64	64	64	1544
LARGE	0.999	32000.0	1072.8	276	477	805	363	240	110	70	37
MEDIUM	0.999	6300.0	329.0	282	488	827	388	304	262	157	74

APPENDIX G
OVERALL SATELLITE FORECAST

G.1 INTRODUCTION

The overall satellite market represents the total amount of traffic addressable by both trunking and CPS satellite systems. These two systems are overlapping for many of the thirty-one services. In some cases, however, traffic from one system cannot be a part of the other; for example, hinterland traffic only applies to CPS systems. An extensive analysis comparing both systems was undertaken in order to arrive at an overall forecast.

G.2 METHODOLOGY

The merging of trunking and CPS required a comparision of the traffic addressable by each of the systems (see Figure G-1). This comparision was done on a cell by cell basis. A cell has 3 dimensions; year, speed and service (see Figure G-2). The unit of the cell is a crossover distance. A comparision of these crossover distances between trunking (T) and CPS (C) is the initial step in determining the overall satellite forecast. If the trunking crossover (T1) is lowest, the net addressable trunking forecast for that cell becomes part of the overall satellite forecast (01). To this is added the CPS hinterland forecast for the corresponding cell (H1). This hinterland traffic is added since it does not exist in the trunking system; however, it does exist in the overall system. If the trunking crossover (T1) is due to (i.e., determined by) the Ka band an additional amount of trunking traffic must be figured since not all trunking traffic can use the Ka band (see Appendix H). This is done by using the MDM and applying the next lowest trunking crossover, either C or Ku, for that cell (T1), for the amount of traffic which cannot go Ka band trunking.

If the CPS crossover (C1) is lowest, the net CPS forecast for that cell becomes part of the overall satellite forecast (01). If the CPS crossover (C1) is due to the Ka band, an additional amount of CPS traffic must be figured since not all CPS traffic can use the CPS band (see Appendix H). This is done by using MDM and applying the next lowest crossover, either C or Ku, for that cell (C1), for the amount of raffic which cannot go Ka band CPS. To that add the portion of the

traffic which can go trunking but which cannot go CPS (see Appendix H). This portion of traffic can be found by using the MDM and applying the trunking crossover for that cell (T1), for that amount of traffic which cannot go CPS.

G.3 NET ADDRESSABLE TRUNKING TRAFFIC

The net addressable trunking traffic forecast is the forecast (expected) found in the Satellite Provided Fixed Communications Service: A Forecast of Potential Domestic Demand through the Year 2000, NASA Contract NAS-3-22894 also prepared by Western Union (Table G-7). The following is a summary of the steps that were performed to determine this traffic.

a. Net Long Haul without Hinterland

Until this point in the analysis, CPS and Trunking forecast were treated identicially. At this point a distinction was made; traffic which fell outside the SMSAs was not considered suitable for transmission over trunking facilities. These percentages were determined through the use of artifical SMSAs (Appendix E).

b. Remove Traffic Not Suitable

The percent of each service's traffic not suitable for satellite transmission was estimated on the basis of internal analysis conducted by engineers familiar with the various services. These percentages are listed by band in Table G1.

c. Cost Analysis

The comprehensive cost analysis required to develop the terrestrial/satellite cross-over distances was applied as it was for CPS. The major activities conducted during this analysis are listed in Table G-2.

d. Determine Operating Speeds

The percent of each service's traffic transmitted at the various operating speeds was estimated on the basis of internal analysis conducted by engineers familiar with the various services. These are given in Table G-3 through G-5.

e. Consider Effect of Common Carrier

The amount of traffic that should be removed because common carriers will choose terrestrial over satellite modes even though

the latter were calculated as more cost efficient was removed next. This is given in Table G-6.

G.4 NET ADDRESSABLE CPS FORECAST

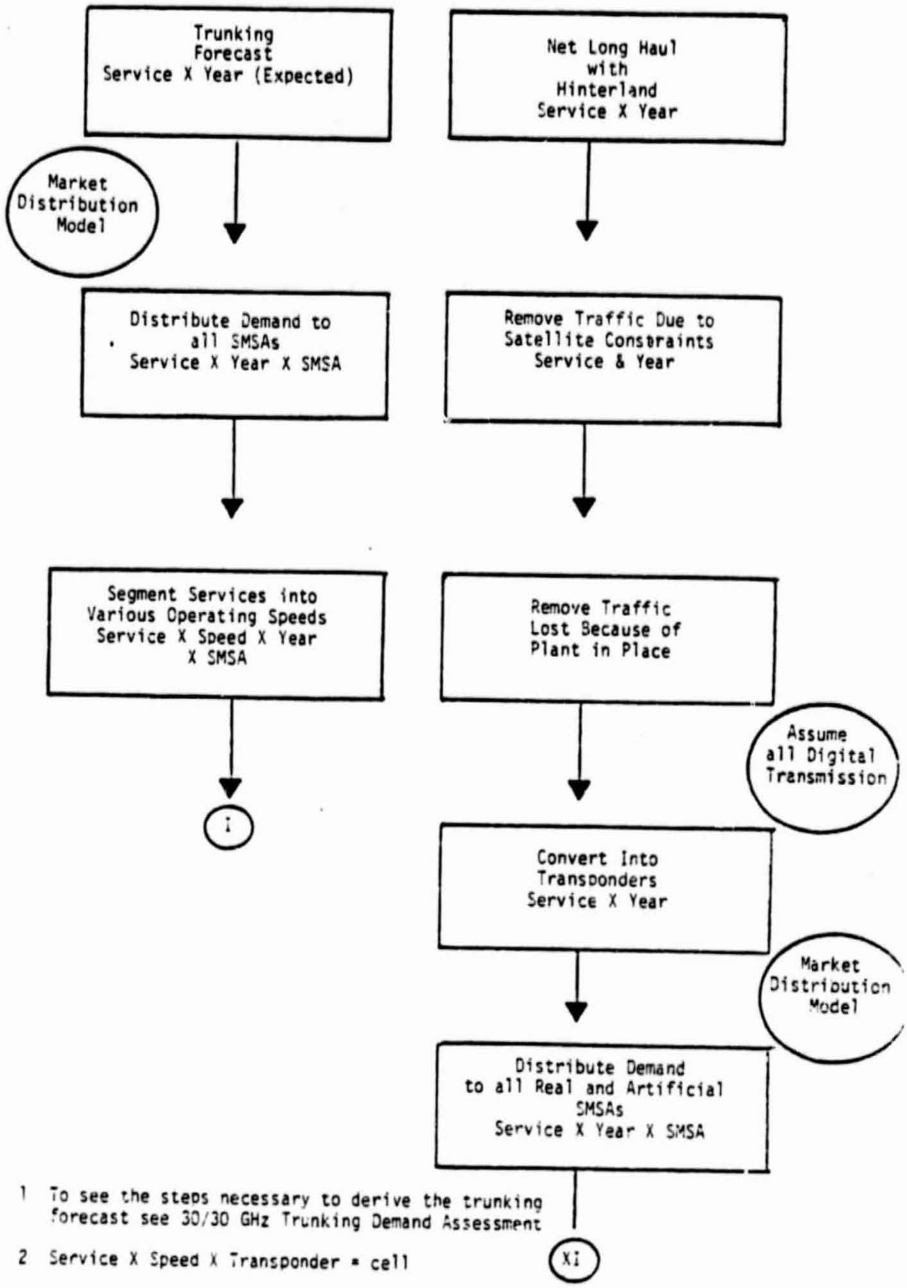
The net addressable CPS forecast is explained in Appendix H.

G.5 NET ADDRESSABLE CPS HINTERLAND FORECAST

This net addressable CPS hinterland forecast is similar to the CPS forecast, however, it only includes traffic to or from sites outside the SMSAs. This was done by creating artificial SMSAs as explained in Appendix H. This include 17,328 routes. The net addressable CPS hinterland forecast by service is shown in Table G-8.

G.6 OVERALL SATELLITE FORECAST

The overall satellite forecast was overlapping and included traffic from both CPS and trunking systems. The trunking segment or the portion of the overall satellite market which is due to trunking is given in Table G-9. The CPS segment is given in Table G-10. The final result of this task is given in Table G-11.



1 To see the steps necessary to derive the trunking forecast see 30/30 GHz Trunking Demand Assessment

2 Service X Speed X Transponder = cell

FIGURE G-1. ACTIVITY FLOW FOR OVERALL SATELLITE FORECASTS

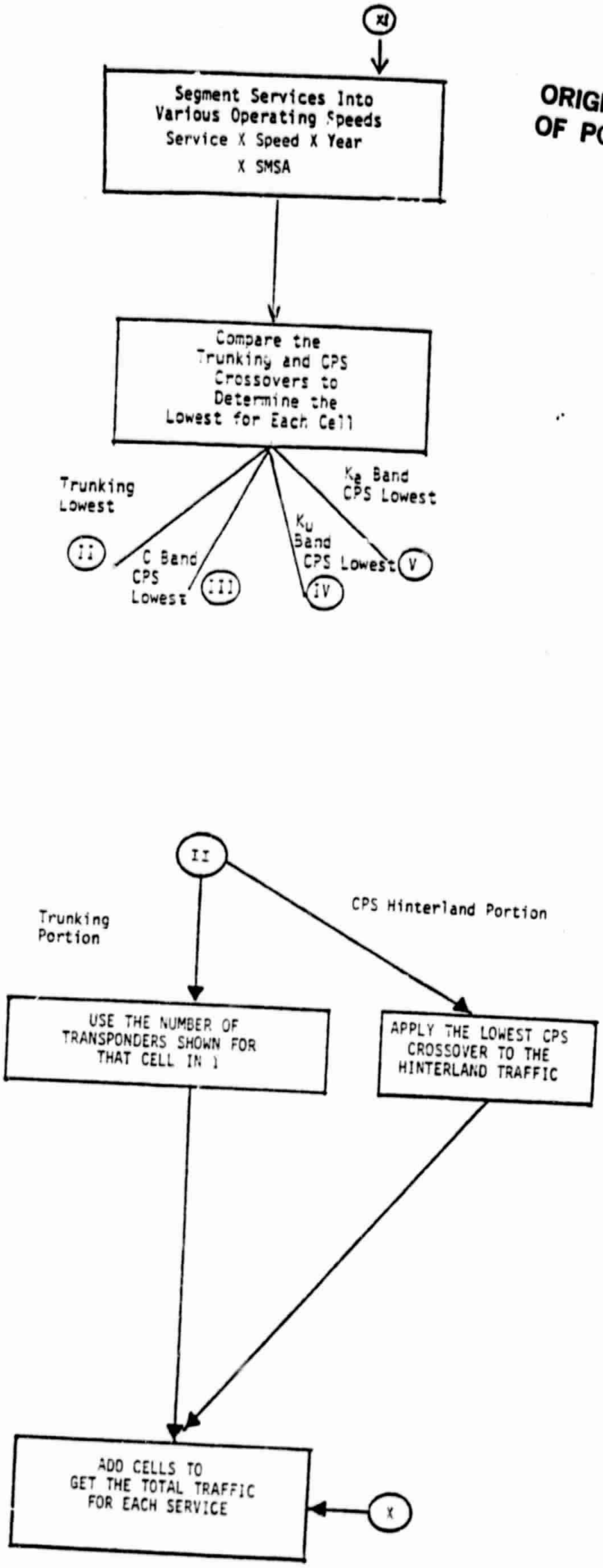


FIGURE G-1, ACTIVITY FLOW FOR OVERALL SATELLITE FORECASTS (Continued)

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OF POOR QUALITY

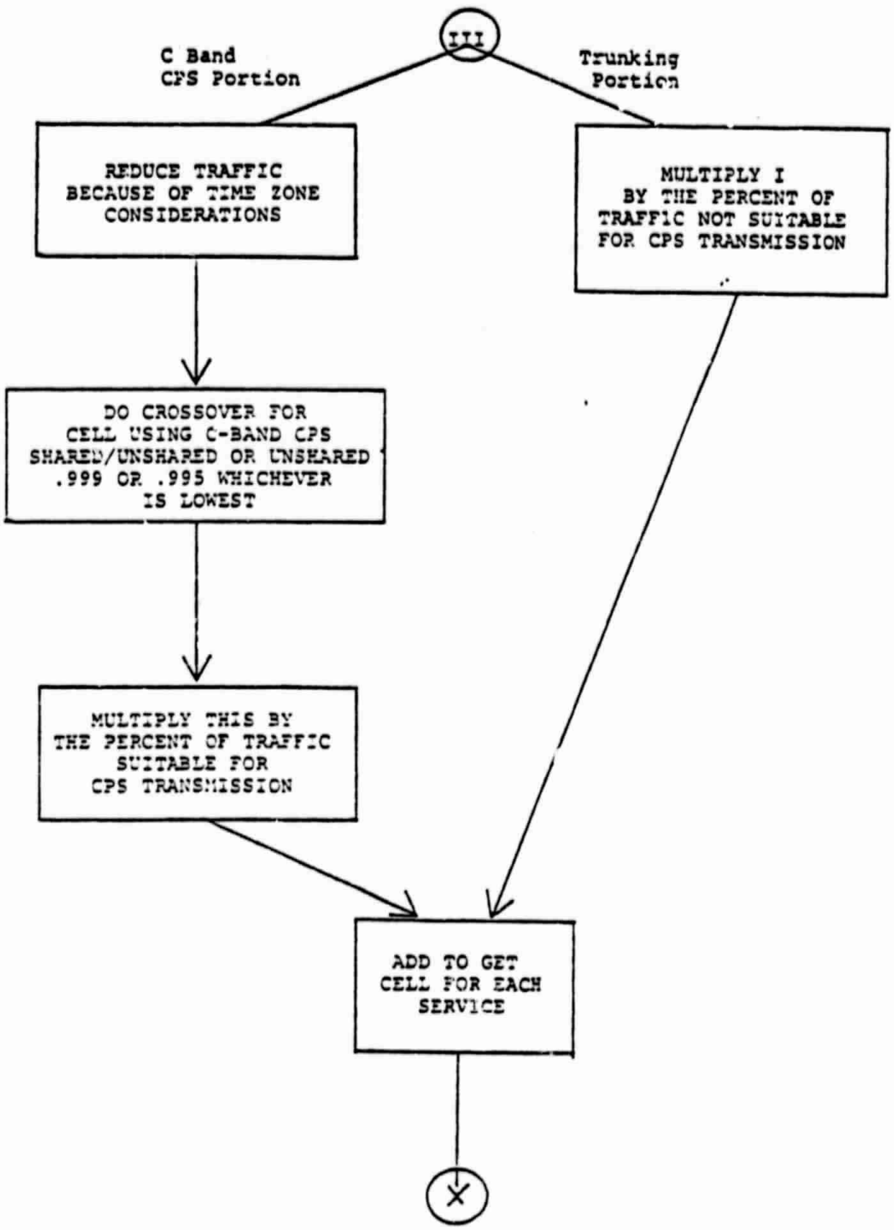

FIGURE G-1, ACTIVITY FLOW FOR OVERALL SATELLITE FORECASTS (Continued)

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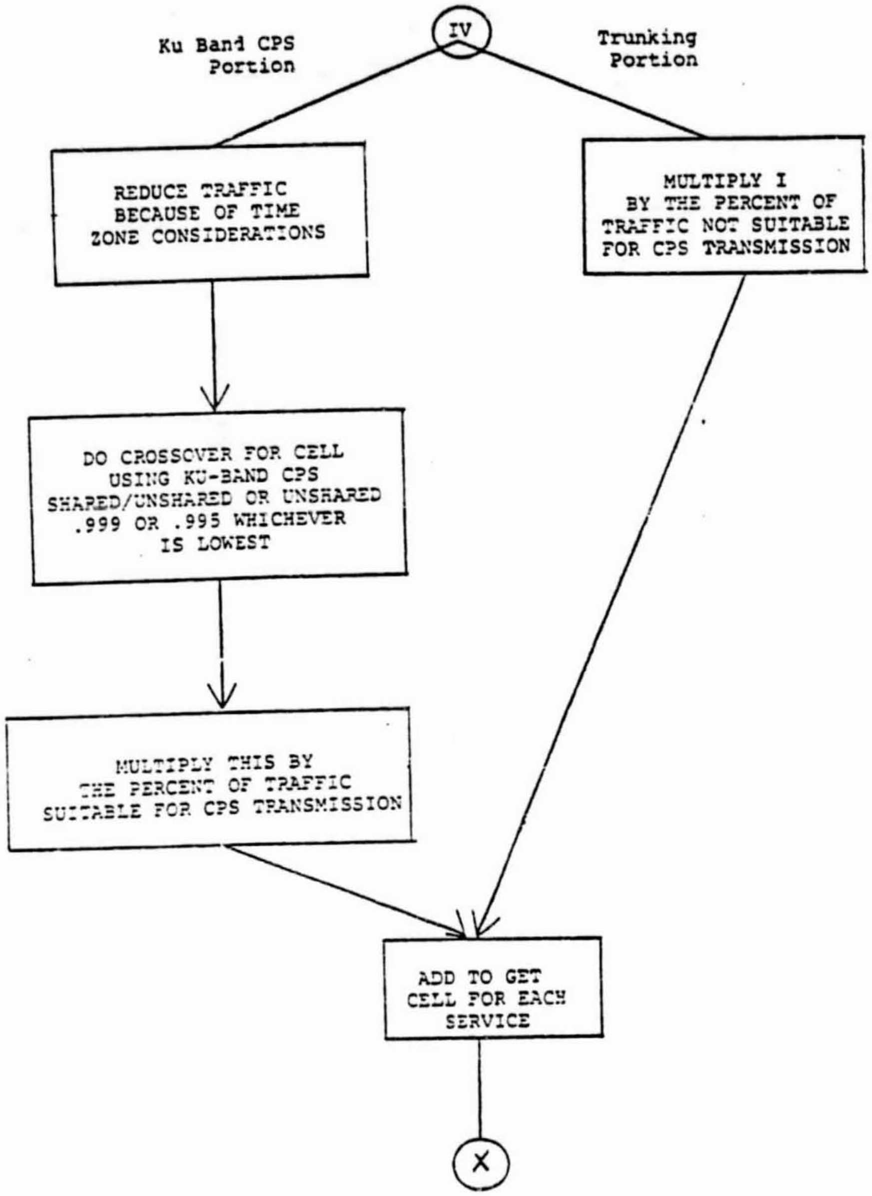

FIGURE G-1, ACTIVITY FLOW FOR OVERALL SATELLITE FORECASTS (Continued)

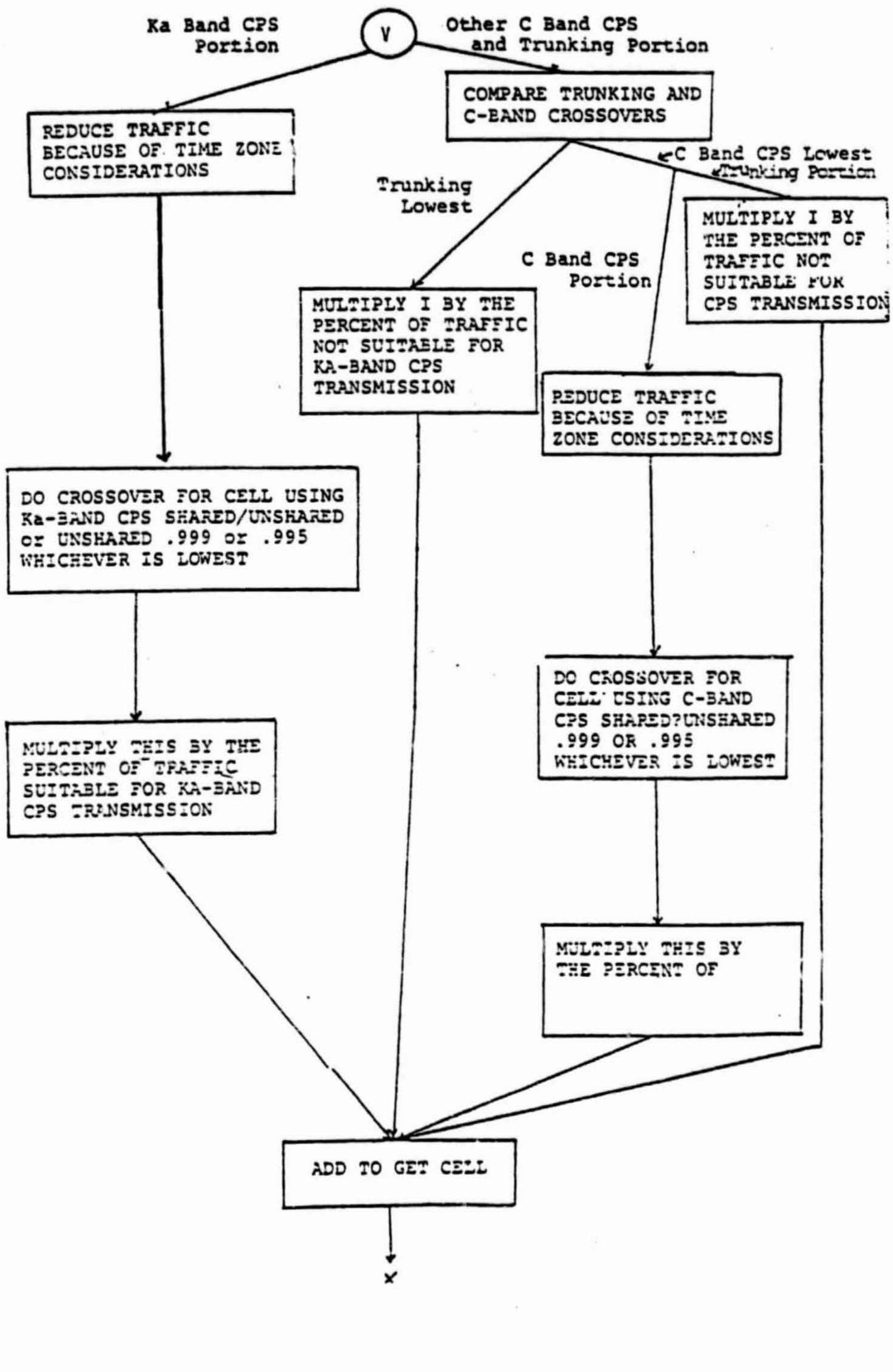

FIGURE G-1, ACTIVITY FLOW FOR OVERALL SATELLITE FORECASTS (Continued)

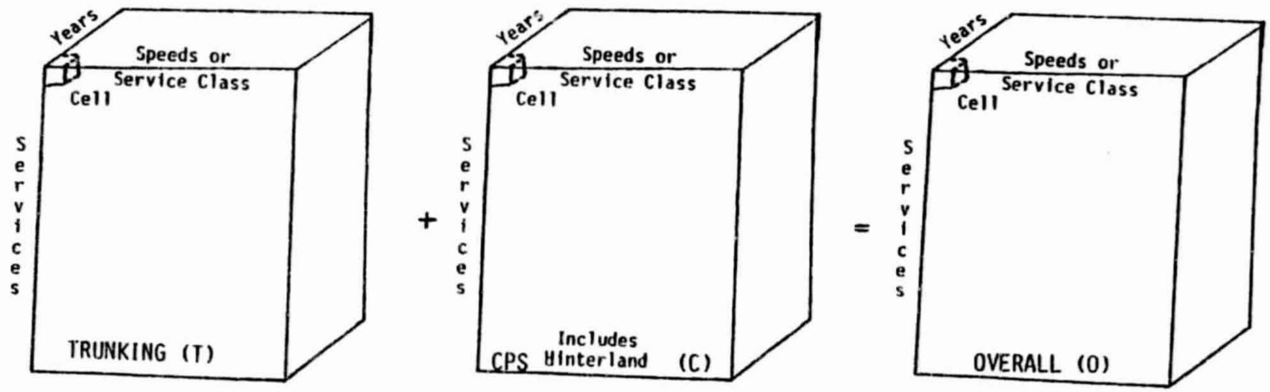

FIGURE G - 2

DIAGRAM OF CELLS INDICATING DIMENSIONS OF YEAR, SPEED AND SERVICF

TABLE G-1
PERCENT OF TRAFFIC NOT
SUITABLE FOR
SATELLITE TRANSMISSION

SERVICES	C	Ku	Ka
MTS (residential)			
MTS (business)			
Private Line			
Mobile			
Public Radio			
Commercial and Religious			30a
Occasional			30a
CATV Music			30a
Recording			
Data Transfer			
Batch Processing			
Data Entry			
Remote Job Entry			
Inquiry/Response	60b	60b	60b
Timesharing	60b	60b	60b
USPS/EMSS			
Mailbox			
Administrative Messages			
Facsimile			
Communicating Word Processors			
TWX/Telex			
Mailgram/Telegram/Money Order			
Point of Sale			
Videotext/Teletext			
Telemonitoring Service			
Secure Voice			
Network			30a
CATV			30a
Occasional			30a
Recording Channel			30a
Teleconferencing			15a

a = Availability

b = Connectivity (i.e., time delay tolerance)

TABLE G-2
MAJOR TRUNKING COSTING ACTIVITIES

- Define the trunking earth stations
- Size the earth stations for C, Ku- and Ka-band
- Vendor Survey to obtain the earth station component costs
- Cost of the earth station
- Cost of the space segment
- Cost of the terrestrial tails. Digital microwave, fiber optics, etc.
- End to end user costs for various trunking services
- Terrestrial tariffs for various services
- Crossover for terrestrial tariffs for various trunking services with satellite trunking systems

TABLE G-3
OPERATING SPEEDS OF SERVICES 1980

SERVICES	2.4	4.8	9.6	56	T-1	Sc1	Sc2	Sc3
MTS (residential)						65	30	5
MTS (business)						65	30	5
Private Line						65	30	5
Mobile						65	30	5
Public Radio								
Commercial and Religious								
Occasional								
CATV Music								
Recording								
Data Transfer			25	70	5			
Batch Processing	70	20	10					
Data Entry	70	20	10					
Remote Job Entry	70	20	10					
Inquiry/Response	70	20	10					
Timesharing	50	20	20	10				
USPS/EMSS	20	10	60	10				
Mailbox	70	20	10					
Administrative Messages	70	20	10					
Facsimile	70	20	10					
Communicating Word Processors	70	20	10					
TWX/Telex	70	20	10					
Mailgram/Telegram/ Money Order	70	20	10					
Point of Sale	70	20	10					
Videotext/Teletext	70	20	10					
Telemonitoring Service	70	20	10					
Secure Voice	20	60	20					
Network								
CATV								
Occasional								
Recording Channel								
Teleconferencing								

TABLE G-4
OPERATING SPEEDS OF SERVICES 1990

SERVICES	2.4	4.8	9.6	56	T-1	Sc1	Sc2	Sc3
MTS (residential)						65	30	5
MTS (business)						65	30	5
Private Line						65	30	5
Mobile						65	30	5
Public Radio								
Commercial and Religious								
Occasional								
CATV Music								
Recording								
Data Transfer			20	50	30			
Batch Processing	20	30	40	10				
Data Entry	20	70	10					
Remote Job Entry	20	70	10					
Inquiry/Response	20	70	10					
Timesharing	20	20	40	20				
USPS/EMSS		10	60	30				
Mailbox	20	70	10					
Administrative Messages	20	70	10					
Facsimile	20	70	10					
Communicating Word Processors	20	70	10					
TWX/Telex	20	70	10					
Mailgram/Telegram/ Money Order	20	70	10					
Point of Sale	20	70	10					
Videotext/Teletext	20	70	10					
Telemonitoring Service	20	70	10					
Secure Voice	20	30	50					
Network								
CATV								
Occasional								
Recording Channel								
Teleconferencing								

TABLE G-5
OPERATING SPEEDS OF SERVICES 2000

SERVICES	2.4	4.8	9.6	56	T-1	Sc1	Sc2	Sc3
MTS (residential)						65	30	5
MTS (business)						65	30	5
Private Line						65	30	5
Mobile						65	30	5
Public Radio								
Commercial and Religious								
Occasional								
CATV Music								
Recording								
Data Transfer			10	20	70			
Batch Processing		30	40	30				
Data Entry	10	20	70					
Remote Job Entry		10	20	70				
Inquiry/Response	10	20	70					
Timesharing		20	20	70				
USPS/EMSS		10	20	70				
Mailbox	10	20	70					
Administrative Messages	10	20	70					
Facsimile	10	20	70					
Communicating Word Processors	20	20	70					
TWX/Telex	10	20	70					
Mailgram/Telegram/ Money Order	10	20	70					
Point of Sale	10	20	70					
Videotext/Teletext	10	20	70					
Telemonitoring Service	10	20	70					
Secure Voice	10	20	70					
Network								
CATV								
Occasional								
Recording Channel								
Teleconferencing								

TABLE G-6
PERCENT OF TRAFFIC REMOVED
BECAUSE OF PLANT IN PLACE

Voice	98	73.5	50.0
Data	93	49.5	16.5
Video	No effect since only satellite traffic forecasted		

TABLE G-7
TRUNKING
NET ADDRESSABLE
EXPECTED
TRANSPONDERS

ORIGINAL PAGE IS
OF POOR QUALITY

	1980	1990	2000
MTS (residential)	3.5	50.6	193.7
MTS (business)	9.0	160.3	647.7
Private Line	174.9	382.9	946.0
Mobile	0.4	5.6	15.8
Public Radio	0.3	0.6	0.6
Commercial and Religious	0.4	0.7	0.7
Occasional	0.7	0.6	0.6
CATV Music	0.1	0.1	0.3
Recording		0.0	0.1
	189.3	601.4	1,805.6
Data Transfer	0.0	0.4	2.7
Batch Processing	0.1	0.7	1.6
Data Entry	9.1	62.5	114.0
Remote Job Entry	0.2	7.1	16.9
Inquiry/Response	0.1	3.2	8.2
Timesharing	0.1	0.8	1.9
USPS/EMSS		0.6	1.8
Mailbox	0.0	0.4	1.0
Administrative Messages	2.2	34.6	99.2
Facsimile	0.5	3.9	5.3
Communicating Word Processors	0.0	0.3	0.9
TWX/Telex	0.0	0.1	0.2
Mailgram/Telegram/Money Orders	0.0	0.0	0.0
Point of Sale	0.1	4.0	6.5
Videotext/Teletext	0.0	1.8	8.1
Telemonitoring Service	0.0	0.0	0.0
Secure Voice	0.0	0.2	1.8
	12.5	120.4	269.9
Network	10.0	42.9	42.0
CATV	34.0	82.4	68.2
Occasional	14.3	41.6	36.0
Recording Channel		0.0	1.3
Teleconferencing	3.0	155.9	245.3
	61.3	322.8	392.7

TABLE G-8. HINTERLAND CPS SEGMENT OF OVERALL SATELLITE FORECASTS (TRANSPONDERS)

ORIGINAL PAGE IS OF POOR QUALITY

SERVICE	YEAR 1980	1990	2000
VOICE			
MTS (RESIDENTIAL)	0.0	0.0	0.0
MTS (BUSINESS)	0.1	1.2	6.5
PRIVATE LINE	0.1	1.8	11.8
MOBILE	0.0	0.0	0.1
PUBLIC RADIO	0.0	0.0	0.0
COMMERCIAL AND RELIGIOUS	0.0	0.0	0.0
OCCASIONAL	0.0	0.0	0.0
CATV MUSIC	0.0	0.0	0.0
RECORDING	0.0	0.0	0.0
TOTAL	0.2	3.1	18.4
DATA			
DATA TRANSFER	0.0	0.1	0.3
BATCH PROCESSING	0.0	0.2	0.5
DATA ENTRY	2.9	18.7	40.2
REMOTE JOB ENTRY	0.1	2.1	5.7
INQUIRY/RESPONSE	0.0	1.0	3.6
TIMESHARING	0.0	0.3	0.7
USPS/EMSS	0.0	0.1	0.3
MAILBOX	0.0	0.1	0.4
ADMINISTRATIVE MESSAGES	0.7	12.0	40.5
FACSIMILE	0.1	0.7	1.2
COMMUNICATING WORD PROCESSORS	0.0	0.1	0.4
TWX/TELEX	0.0	0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS	0.0	0.0	0.0
POINT OF SALE	0.0	1.2	2.3
VIDEOTEXT/TELETEXT	0.0	0.0	0.0
TELEMONITORING SERVICE	0.0	0.0	0.0
SECURE VOICE	0.0	0.0	0.6
TOTAL	3.9	36.6	96.8
VIDEO			
NETWORK	0.0	0.0	0.0
CATV	0.0	0.0	0.0
OCCASIONAL	0.0	0.0	0.0
RECORDING CHANNEL	0.0	0.0	0.0
TELECONFERENCING	0.1	9.6	20.0
TOTAL	0.1	9.6	20.0

TABLE G-9. TRUNKING SEGMENT OF OVERALL SATELLITE FORECASTS (TRANSPONDERS)

SERVICE	YEAR 1980	1990	2000
VOICE			
MTS (RESIDENTIAL)	3.5	50.6	193.7
MTS (BUSINESS)	9.0	160.3	647.7
PRIVATE LINE	174.9	382.9	946.0
MOBILE	0.4	5.6	15.8
PUBLIC RADIO	0.3	0.6	0.6
COMMERCIAL AND RELIGIOUS	0.4	0.7	0.7
OCCASIONAL	0.7	0.6	0.6
CATV MUSIC	0.1	0.1	0.3
RECORDING	0.0	0.0	0.1
TOTAL	189.3	601.4	1805.6
DATA			
DATA TRANSFER	0.0	0.4	2.7
BATCH PROCESSING	0.0	0.0	0.0
DATA ENTRY	0.0	0.0	0.0
REMOTE JOB ENTRY	0.0	0.0	0.0
INQUIRY/RESPONSE	0.0	0.0	0.0
TIMESHARING	0.0	0.0	0.0
USPS/EMSS	0.0	0.6	1.8
MAILBOX	0.0	0.0	0.0
ADMINISTRATIVE MESSAGES	0.0	0.0	0.0
FACSIMILE	0.0	0.0	0.0
COMMUNICATING WORD PROCESSORS	0.0	0.0	0.0
TWX/TELEX	0.0	0.1	0.2
MAILGRAM/TELEGRAM/MONEY ORDERS	0.0	0.0	0.0
POINT OF SALE	0.0	0.0	0.0
VIDEOTEXT/TELETEXT	0.0	1.8	8.1
TELEMONITORING SERVICE	0.0	0.0	0.0
SECURE VOICE	0.0	0.0	0.0
TOTAL	0.1	2.9	12.8
VIDEO			
NETWORK	10.0	42.9	42.0
CATV	34.0	82.4	68.2
OCCASIONAL	14.3	41.6	36.0
RECORDING CHANNEL	0.0	0.0	1.3
TELECONFERENCING	3.0	155.9	245.3
TOTAL	61.3	322.8	392.7

TABLE G-10. CPS SEGMENT OF OVERALL SATELLITE FORECASTS (TRANSPONDERS)

SERVICE	YEAR 1980	1990	2000
VOICE			
MTS (RESIDENTIAL)	0.0	0.0	0.0
MTS (BUSINESS)	0.1	1.2	6.5
PRIVATE LINE	0.1	1.8	11.8
MOBILE	0.0	0.0	0.1
PUBLIC RADIO	0.0	0.0	0.0
COMMERCIAL AND RELIGIOUS	0.0	0.0	0.0
OCCASIONAL	0.0	0.0	0.0
CATV MUSIC	0.0	0.0	0.0
RECORDING	0.0	0.0	0.0
TOTAL	0.2	3.1	18.4
DATA			
DATA TRANSFER	0.0	0.1	0.3
BATCH PROCESSING	0.1	1.1	3.1
DATA ENTRY	16.1	102.2	219.9
REMOTE JOB ENTRY	0.4	11.6	31.0
INQUIRY/RESPONSE	0.2	5.3	19.6
TIMESHARING	0.1	1.4	3.7
USPS/EMSS	0.0	0.1	0.3
MAILBOX	0.0	0.8	2.2
ADMINISTRATIVE MESSAGES	3.9	65.6	221.5
FACSIMILE	0.7	5.7	8.6
COMMUNICATING WORD PROCESSORS	0.0	0.5	2.1
TWX/TELEX	0.0	0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS	0.0	0.0	0.0
POINT OF SALE	0.1	6.9	13.2
VIDEOTEXT/TELETEXT	0.0	0.0	0.0
TELEMONITORING SERVICE	0.0	0.0	0.1
SECURE VOICE	0.0	0.3	3.3
TOTAL	21.7	201.5	528.8
VIDEO			
NETWORK	0.0	0.0	0.0
CATV	0.0	0.0	0.0
OCCASIONAL	0.0	0.0	0.0
RECORDING CHANNEL	0.0	0.0	0.0
TELECONFERENCING	0.1	9.6	20.0
TOTAL	0.1	9.6	20.0

TABLE G-11. OVERALL SATELLITE FORECASTS (TRANSPONDERS)

SERVICE	YEAR 1980	1990	2000
VOICE			
MTS (RESIDENTIAL)	3.5	50.6	193.7
MTS (BUSINESS)	9.1	161.5	654.2
PRIVATE LINE	174.9	384.8	957.8
MOBILE	0.4	5.6	15.9
PUBLIC RADIO	0.3	0.6	0.6
COMMERCIAL AND RELIGIOUS	0.4	0.7	0.7
OCCASIONAL	0.8	0.6	0.6
CATV MUSIC	0.1	0.1	0.3
RECORDING	0.0	0.0	0.1
TOTAL	189.4	604.5	1824.0
DATA			
DATA TRANSFER	0.0	0.5	3.0
BATCH PROCESSING	0.1	1.1	3.1
DATA ENTRY	16.1	102.2	219.9
REMOTE JOB ENTRY	0.4	11.6	31.0
INQUIRY/RESPONSE	0.2	5.3	19.6
TIMESHARING	0.1	1.4	3.7
USPS/EMSS	0.0	0.6	2.2
MAILBOX	0.0	0.8	2.2
ADMINISTRATIVE MESSAGES	3.9	65.6	221.5
FACSIMILE	0.7	5.7	8.6
COMMUNICATING WORD PROCESSORS	0.0	0.5	2.1
TWX/TELEX	0.1	0.2	0.2
MAILGRAM/TELEGRAM/MONEY ORDERS	0.0	0.0	0.0
POINT OF SALE	0.1	6.9	13.2
VIDEOTEXT/TELETEXT	0.0	1.8	8.1
TELEMONITORING SERVICE	0.0	0.0	0.1
SECURE VOICE	0.0	0.3	3.3
TOTAL	21.7	204.4	541.6
VIDEO			
NETWORK	10.0	42.9	42.0
CATV	34.0	82.4	68.2
OCCASIONAL	14.3	41.6	36.0
RECORDING CHANNEL	0.0	0.0	1.3
TELECONFERENCING	3.1	165.5	265.3
TOTAL	61.3	332.4	412.7

APPENDIX H
CPS SATELLITE MARKET

H.1 INTRODUCTION

The CPS satellite forecast represents the total amount of traffic addressable by a CPS satellite system. The most distinguishing feature between a CPS and trunking system is the amount of traffic aggregation which occurs. With CPS one of two types of systems exist; one with small earth stations located directly on the customer's premise and one with local customer shared earth stations with dedicated tail connections directly to the sharing customers. Trunking uses public lines to transmit the information over to and from a central earth station.

H.2 METHODOLOGY

To derive the addressable CPS forecast it is necessary to begin with the net long haul (see Figure H-1). A series of steps must then be performed reducing traffic for various reasons, and making comparisions of the crossovers due to various bands. The assumption is made that CPS traffic will be all digital. This is based on trends to totally integrated networks. The following steps were performed to determine this traffic.

H.2.1 Remove Traffic Due to Satellite Constraints

Unacceptable user and application characteristics refer to usage and technical considerations which play a part in determining the suitability of a particular application for implementation on a satellite transmission system (see Table H-1). Among the qualification criteria evaluated in determining satellite implementation suitability were the following:

a. Satellite Delay

What is the ability of an application to tolerate a 600 millisecond delay cuased by transmission via satellite? In data applications, this represents the delay between sending a block of information and the acknowledgement of its correct reception.

b. <u>Accommodation of satellite delay</u>

What effect will the cost and required technology necessary to overcome some satellite delay problems have on demand? Included are the costs of software conversion or special equipment, the projection of their availability and ease of implementation.

c. <u>Multipoint signal distribution</u>

What are the requirements of each application for broadcast-type signal distribution? The C-band CONUS coverage easily accommodates multipoint requirements such as are associated with the Network Video application, while Ku-band implementation of multipoint distribution requires a separate half channel for each additional drop. (The Ka-band system model is a point-to-point system, not adaptable to broadcast services.)

d. <u>Urgency of message delivery</u>

How tolerant will users be to service interruptions and outages in excess of that experienced on terrestrial transmission media such as the public switched network? Movement to higher transmission frequencies is accompanied by the potential for lower levels of service availability. The impact of reduced availability varies with each application.

e. <u>Miscellaneous characteristics</u>

Several minor service considerations were also evaluated. They included: joint use of existing facilities, which may cause facility requirements to reflect the principal usage rather than the subordinate usage; and, insufficient traffic volume of a specific application to justify special communications facilities.

Quantification of these qualifying criteria included several conditions. Some were fundamental to the separation of satellite and terrestrial traffic (satellite delay), some were necessary to separate different forms of a satellite transmission (multipoint signal distribution), and some were time oriented (accommodation of satellite delay). Each of the 31 service applications were evaluated for each characteristic in current terms (1980) and for the year 2000, based on trends established by judgement and analysis. Intermediate years also were evaluated if a significant change in trend was anticipated. A factor was

established for each criterion for 1980 and 2000 which defined the proportion of market demand associated with a particular service application that could tolerate the requirements of the criterion. The individual factors derived for each criterion were consolidated into a composite qualifying factor and applied to the net long haul market demand for each application and each year of the 1980-2000 time span by computer modelling techniques. This completed the first step.

H.2.2 Remove Traffic Lost Because of Plant in Place

There exist across the United States a tremendous investment in existing plant in place. Such things as AT&T's and Western Union's extensive microwave systems were largely installed several years ago. Once this plant is installed it becomes a sunk cost. The marginal cost is the cost of maintaining the system. This is the true cost which satellite systems must recover. As competition increases companies will compete not so much on a tariff basis but on a service basis, for example a voice grade line New York to Los Angeles. Terrestrial systems will tend to underbid their true cost of offering the service in order to cover the cost of maintaining their present system and covering some of the sunk cost.

As the marginal cost of maintaining the plant in place increases, as the equipment becomes older, and the cost of providing services by satellite become cheaper a higher percentage of the market will be captured by satellites. This is reflected in the percent of satellite addressable traffic removed because of existing plant in place (Table H-2). These percentages were obtained by consulting tariff experts and engineers. The major impact was expected to be on voice since the current plant in place was established mainly to handle this type of traffic. The percent of data to remove was estimated by using the percent of data which uses voice facilities times the percent of voice traffic to remove because of plant in place (see Appendix E).

H.2.3 Convert into Transponders

Up to this point voice, data, and video were all carried in unique units; half voice circuits for voice, terabits for data and transponders for video. In order to project the net addressable CPS traffic and the number of satellites this service

requires, it was necessary to convert these units into a common unit, transponders. It was assumed that CPS traffic would be entirely digital. This was based on the nature of CPS, mostly intra company and to a large extent digital to begin with. The following steps were performed to convert the various units to transponders.

a. Voice

To convert half-voice circuits into transponders required two steps. The initial step was to determine the number of bits required to transmit a half-voice circuit. Relying on our engineering analysis of future trends the following number of bits were determined to be needed to code a half-voice circuit.

1980	1990	2000
64	32	24

These are typical of the number of bits it will take to encode a half-voice circuit. While it has been shown possible to encode a half voice circuit in as few as 16 Kbps (perhaps even less) the typical circuit today uses 64 Kbps. By 1990 this typical is expected to decline to 32 Kbps. By 2000 a mixture of 50 percent encoded at 32 Kbps and 50 percent at 16 Kbps is foreseen. Using these typical rates the number of bits needed to transmit the voice traffic was calculated.

The second step to convert half-voice circuits into transponders was to divide by the amount of data throughput a CPS transponder could handle. These numbers were found as explained below in the data section.

b. Data

To convert terabits into transponders, it was necessary to calculate the number of bits which a CPS transponder could handle. An analysis was made considering that the typical CPS earth station would be small and that several would utilize the same transponder simultaneously. As more earth stations utilize the same transponder the overhead (bandwidth) required increases and the efficiency declines. Using this the following data rates were found to be typical.

MBPS PER TRANSPONDER

1980	1990	2000
36	52.5	52.5

c. Video

The number of transponders needed for video was the basic unit established for those services in producing the baseline. Such things as compression of video signals and the ability to transmit more than one signal over a transponder were considered there. Therefore, no adjustments were needed to convert the video services to CPS transponders. (In addition all video services except teleconferencing are eliminated because of the very nature of CPS.)

H.2.4 Distributed Demand to all Real and Artificial SMSAs

In order to distribute the demand for transponders among the 313 SMSAs and the 48 artificial SMSAs it was necessary to use the market distribution model (see Appendix C). Table H-3 shows the files and weights used to perform this distribution.

H.2.5 Segment Services into Various Operation Speeds

The next step is to segment the thirty-one services into the various operating speeds. This analysis done by engineers reviewed such things as the trend toward more high speed data. Services involving a great deal of CPU to CPU traffic which would normally go over high volume circuits were shown as such, for instance, data transfer. Slower services, such as data entry, were segmented into the slower speeds. Tables H4-H6 show this for the three years.

H.2.6 Reduce Traffic Because of Time Zone Considerations

Peak hour traffic does not consider the different time zones within the continental United States. For instance if the peak hour for traffic occurs at 2:00 p.m., it is calculated as 2:00 p.m. across the United States. If the satellite system has sufficient capability it may be reconfigured and the antennas

reshaped to take advantage of the different time zones. An analysis of this effect and the impact on system traffic was performed by Western Union under contract to Motorola (NASA Contract NAS3-22895). In summary it was found that a system may be designed for 13 percent less traffic if the system takes advantage of the various time zones. The time zones for the continental U.S. are shown in igure H-2. igure H-3 shows the peak hour traffic curve after time zones were considered (note: the traffic number refers to the Motorola study not the current study).

Other aspects of modifying the peak hour were also reviewed such as seasonal variations or the effect of future population shifts, seasonal variations were found to have spikes on certain days such as Christmas or tax time which are not sustained enough to justify a larger system. The effect of the population shift on traffic was also found to be insignificant. Figure H-4, from the Motorola study, shows this effect.

H.2.7 Remove Traffic not Suitable for CPS Transmission

Not all traffic was suitable for inclusion in a CPS satellite system. There were several considerations as to the percentage of traffic to be removed. First broadcast applications were difficult if not impossible for a CPS system and were largely removed. Private homes would have very little communication and not use a CPS system so traffic generated there, such as residential message toll service, was removed. In addition a great deal of interbusiness traffic would be between companies not on the CPS system and therefore should not be included as addressable. In addition because of the beam size and the multiple use of the Ka Band an additional amount of traffic was removed. Table H-7 shows the percentage of traffic removed because it was not suitable for CPS transmission.

H.2.8 Crossover Distances

In Appendix F costing analysis has been described in detail and crossover distances computed. Four types of earth stations with varying traffic capacity were considered. For CPS application only TDMA approach was used as it supports all types of traffic i.e., voice, data and video. To satisfy different CPS network traffic requirements the earth stations were designed with various burst rates. The earth stations were either unshared or shared by the customer. In the

former case the customer was collocated with the earth station, in the later case the customer had dedicated terrestrial tail circuits. The composite crossover concept was developed and used in Figure H-1. The composite crossover distance is defined to be the weighted sum of the individual crossover distances of the earth stations. Table H-8 summarizes the CPS earth station characteristics and the weight assigned to each earth station type for unshared application, while Table H-9 summarized the CPS earth station characteristics for the weight assigned to each earth station type for shared application. Using these tables and the results of Appendix F the composite crossover distances were computed for shared and unshared applications with .995 and .999 availability. Tables H-10 and H-11 present the composite crossover distances for unshared earth stations with .999 and .995 availability, while Tables H-12 and H-13 present the composite crossovers for shared application with .999 and .995 availability.

A comparision of the trunking and CPS crossovers were made next. Some traffic which economically would go trunking would likely be included on a CPS system as secondary traffic once the system was installed. The most likely candidate would be business message toll service. After establishing an intra business CPS system based on cost effectiveness, a company would likely include some of the intra business telephone service. For the same reason it was decided that wherever the trunking/CPS crossover favored trunking 10 percent of the traffic would be addressable by CPS. The next step depends on which CPS crossover is the lowest.

H.2.9.1 C or Ku Band Crossover Lowest

If the C or Ku crossover is the lowest (see Appendix F), the crossover is applied for that particular speed across all 31 services and across all real and artificial SMSAs using MDM. This provides one set of cells. When all the crossovers are applied the cells are added to determine the traffic for each service.

H.2.9.2 Ka Band Crossover Lowest

If the Ka-band crossover is the lowest, two portions of the traffic must be determined. One portion is that percentage of the traffic which is suitable for

Ka-band CPS transmission. This is found by first applying the Ka Band CPS crossover using MDM and then multiplying the traffic by the percent of traffic suitable for Ka band CPS transmission. The second portion is found by applying the next lowest crossover either C or Ku to the traffic using MDM and then multiplying by the percent of traffic suitable for CPS transmission but not suitable for Ka transmission.

H.2.10 CPS Satellite Report

This report shows the net addressable CPS traffic (Table H-14). It is composed of C, Ku and Ka traffic depending on the lowest crossover for each particular service and speed. The first column gives the name of the service forecasted. At the end of each group of services, voice, data and video subtotals are given. The next three columns present the traffic forecast in transponders for 1980, 1990 and 2000.

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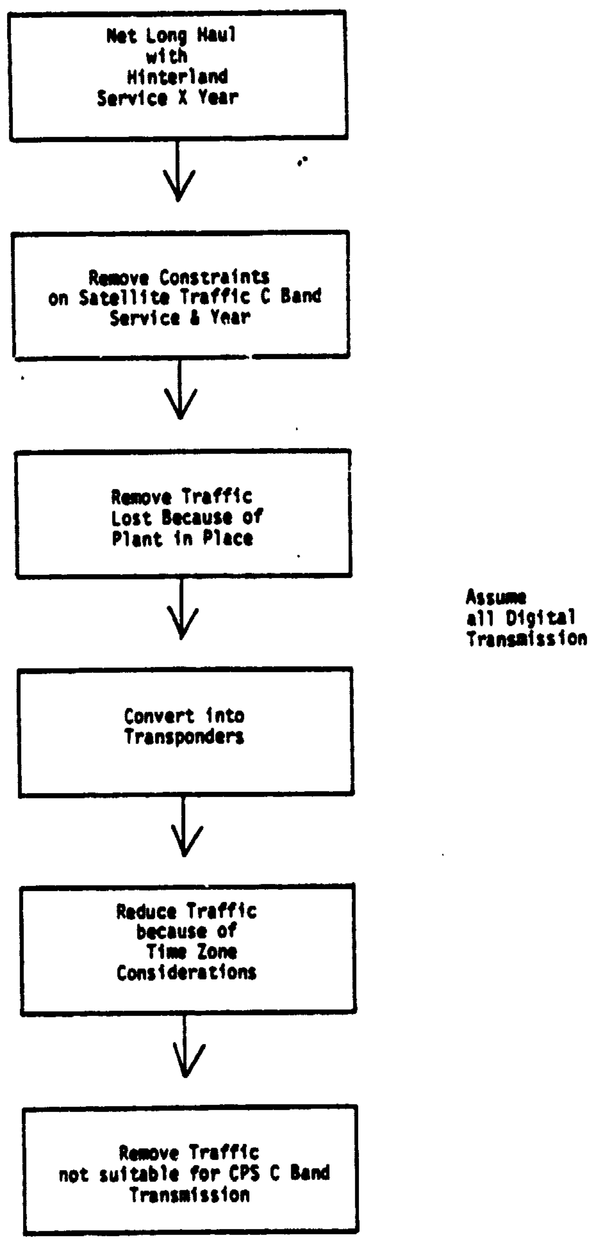

FIGURE H-1 ACTIVITY FLOW FOR CPS SATELLITE MARKET

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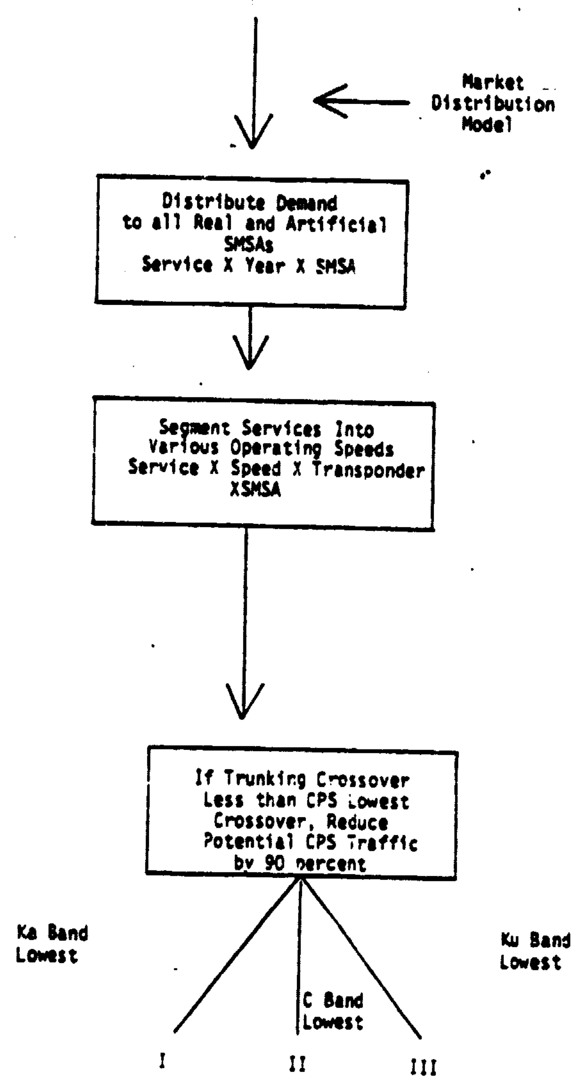

FIGURE H-1 ACTIVITY FLOW FOR CPS SATELLITE MARKET

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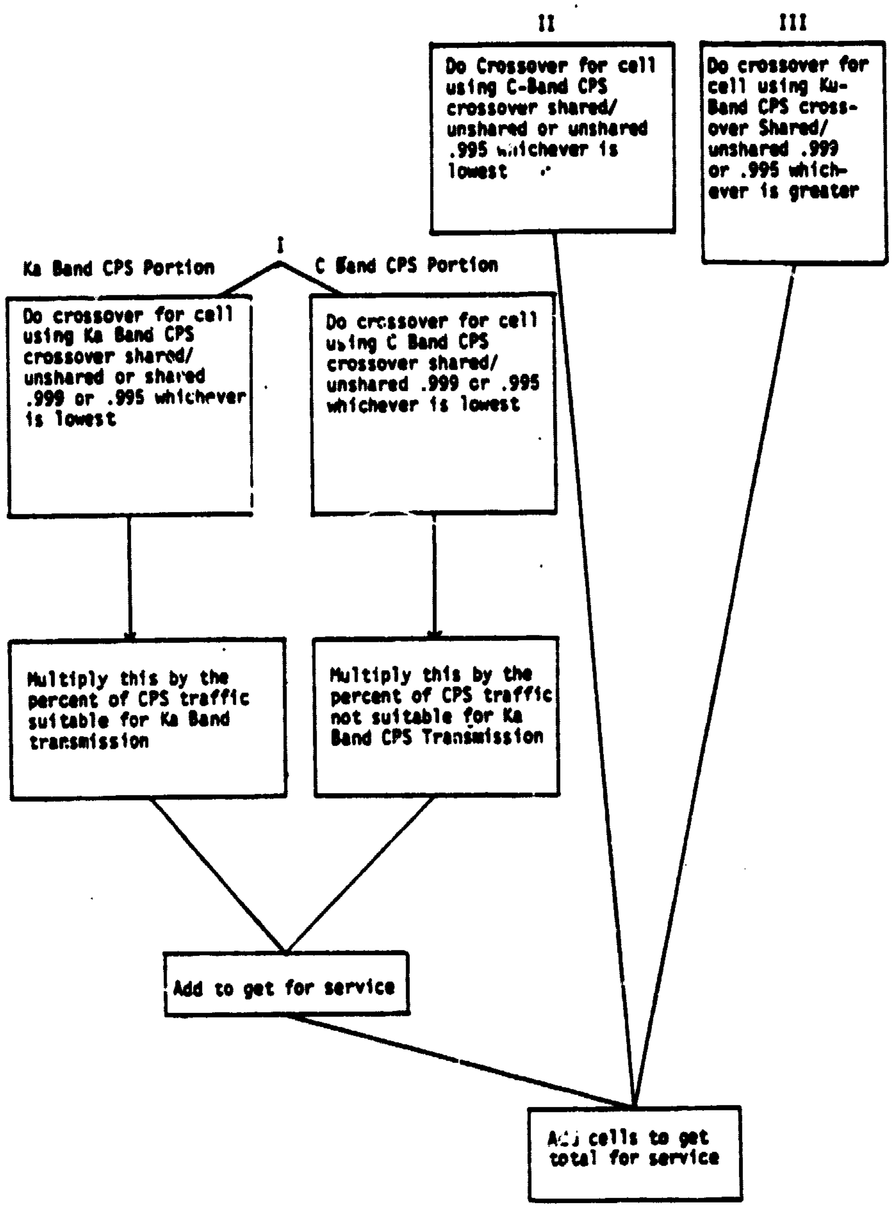

FIGURE H-1 ACTIVITY FLOW FOR CPS SATELLITE MARKET

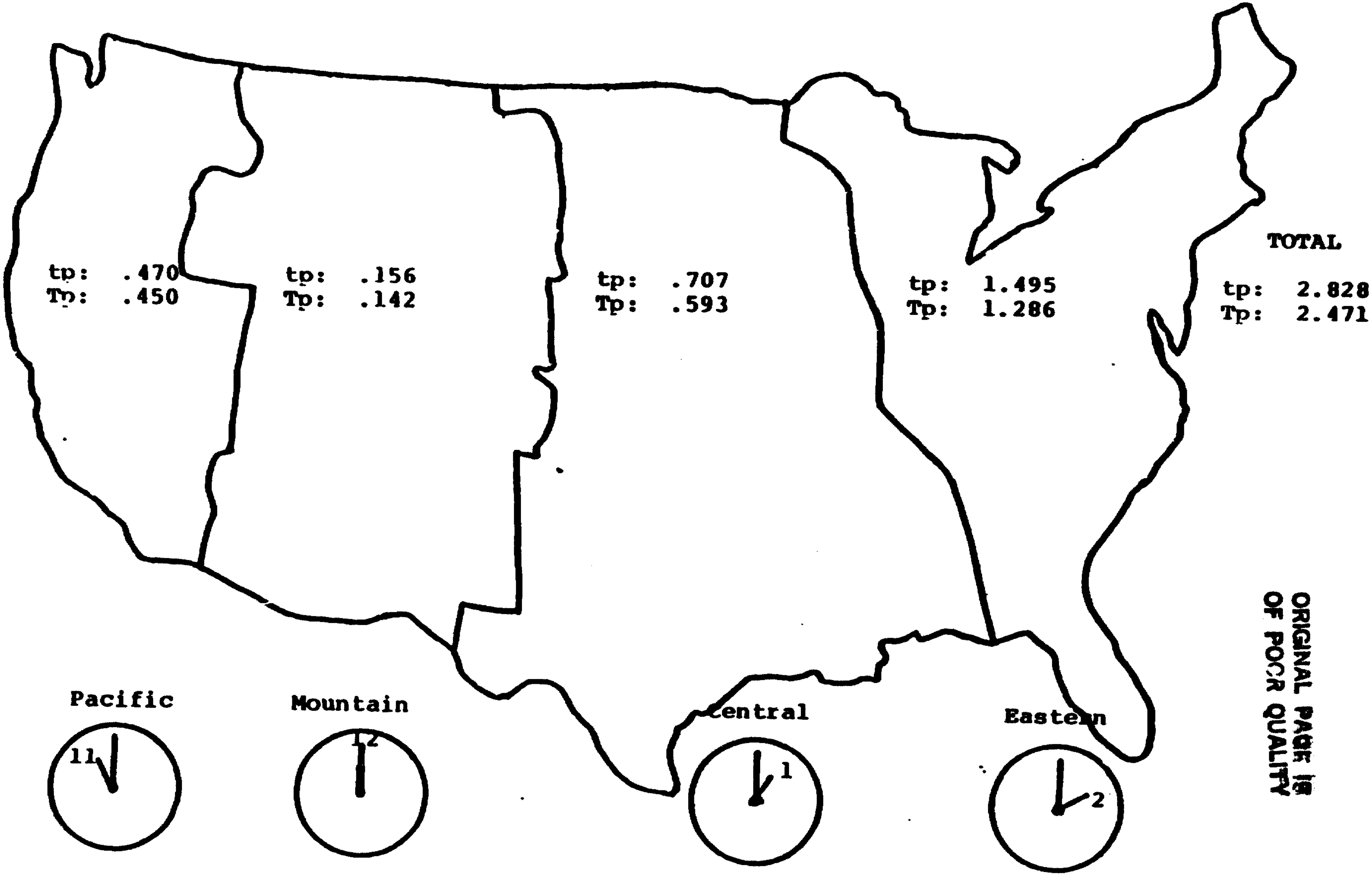

FIGURE H-2. U.S. TIME ZONES AND PEAK HOUR GENERATED TRAFFIC

- Not considering time zones or population shifts (tp)
- Considering time zones, but not population shifts (Tp)

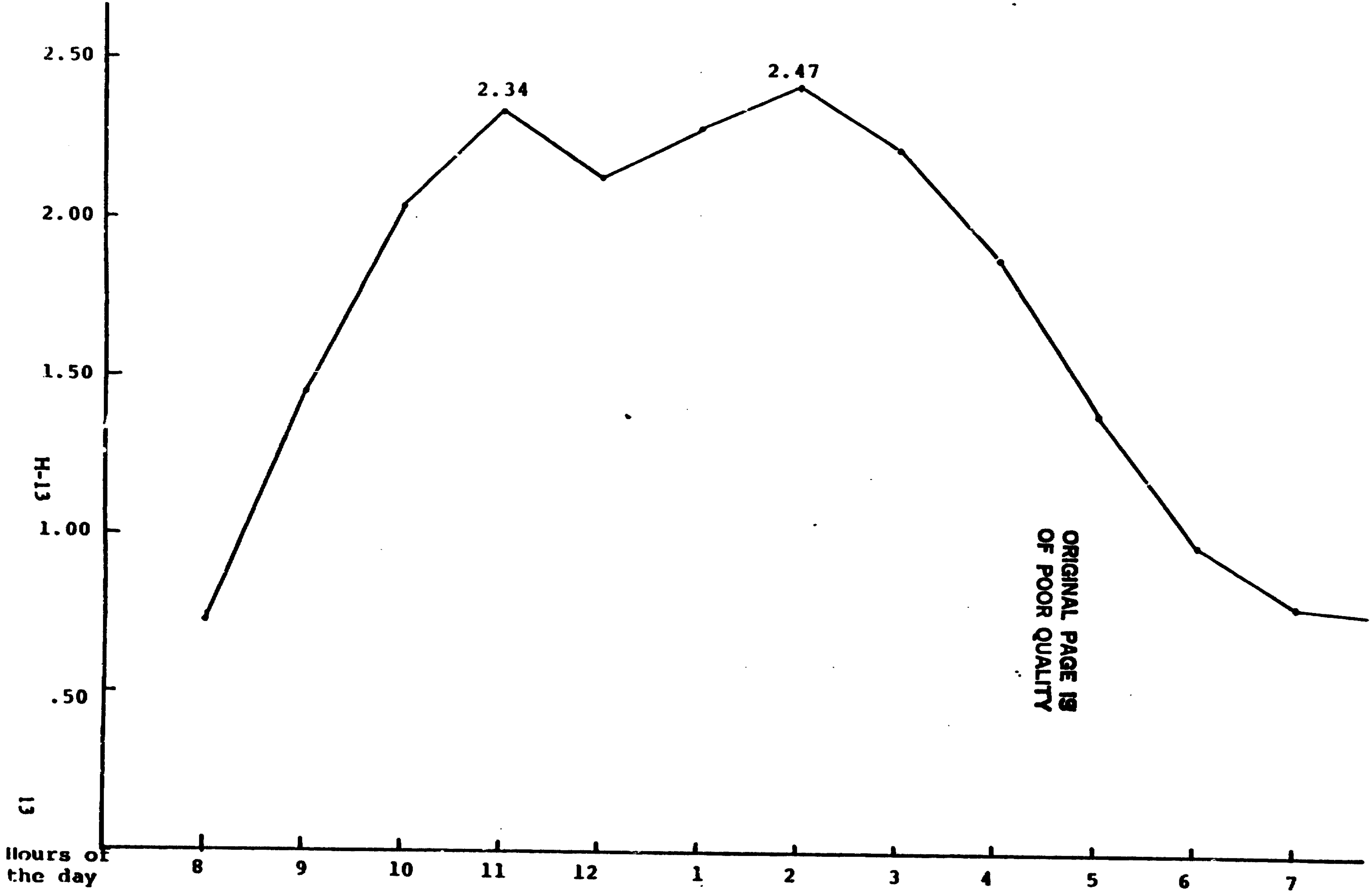

FIGURE H-3. U.S. PEAK HOUR TRAFFIC CONSIDERING TIME ZONES
MODEL B Year = 1982

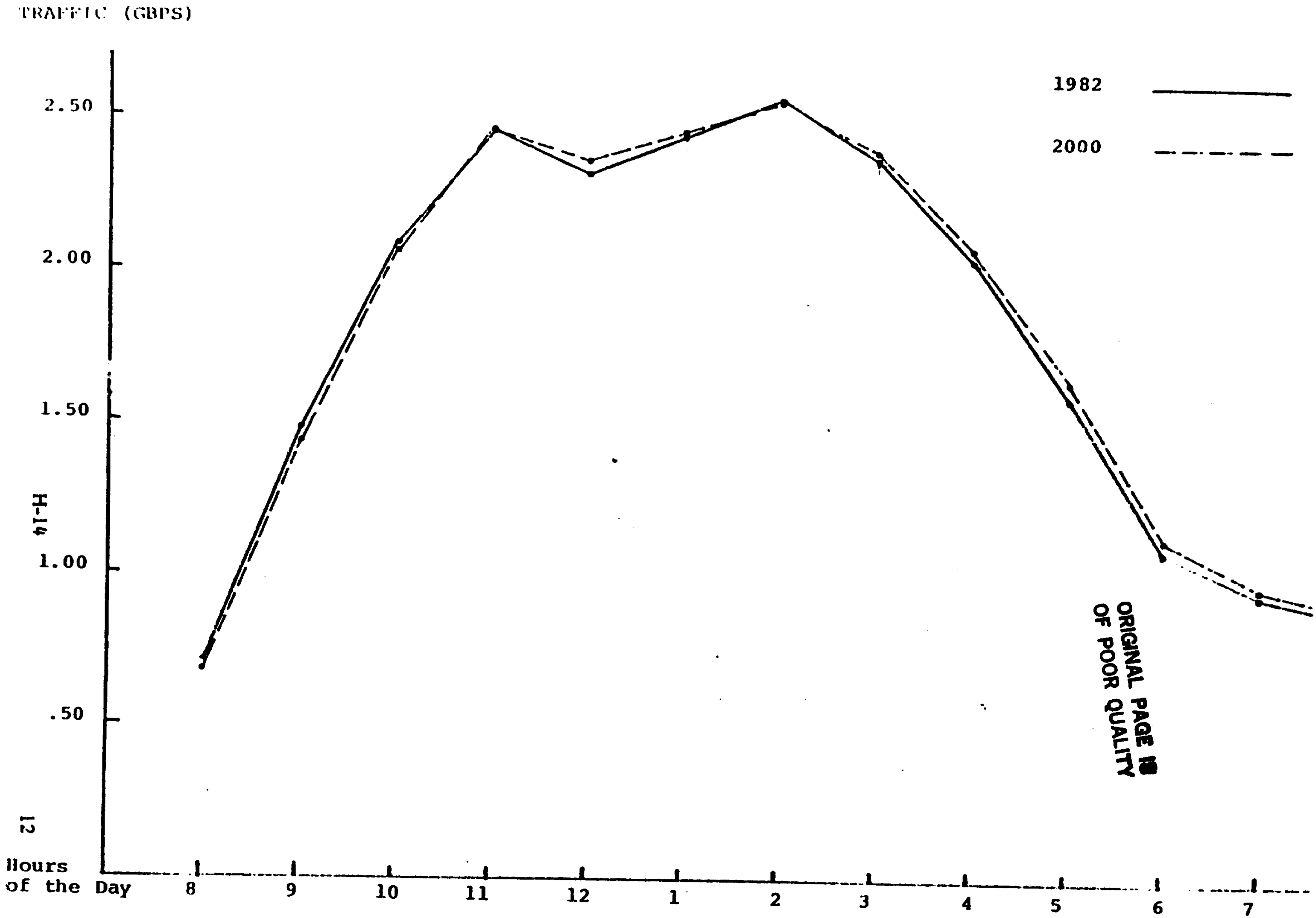

FIGURE H-4. COMPARISION OF U.S. PEAK HOUR TRAFFIC CONSIDERING TIME ZONES
MODEL A YEARS = 1982, 2000

TABLE H-1
PERCENT OF TRAFFIC NOT SUITABLE FOR SATELLITE TRANSMISSION

SERVICES	C	Ku	Ka
MTS (residential)			
MTS (business)			
Private Line			
Mobile			
Public Radio			
Commercial and Religious			30a
Occasional			30a
CATV Music			30a
Recording			
Data Transfer			
Batch Processing			
Data Entry			
Remote Job Entry			
Inquiry/Response	60b	60b	60b
Timesharing	60b	60b	60b
USPS/EMSS			
Mailbox			
Administrative Messages			
Facsimile			
Communicating Word Processors			
TWX/Telex			
Mailgram/Telegram/Money Order			
Point of Sale			
Videotext/Teletext			
Telemonitoring Service			
Secure Voice			
Network			30a
CATV			30a
Occasional			30a
Recording Channel			30a
Teleconferencing			15a

a = Availability

b = Connectivity (i.e., time delay tolerance)

TABLE H-2
PERCENT OF TRAFFIC REMOVED
BECAUSE OF PLANT IN PLACE

SERVICE	YEAR 1980	1990	2000
Voice	98	73.5	50.0
Data	93	49.5	16.5
Video	No effect since only satellite traffic forecasted		

TABLE H-3
WEIGHTING FOR MDM

FILE	SOURCE	WEIGHT
Population	1980 Census	30
1980 Business Telephones	AT&T	35
Bank Deposits	Dept. of Commerce	10
Non-Farm Employment	Bureau of Economic Affairs	15
Number of Computer Sites	Internation Data Corp.	10

TABLE H-4
OPERATING SPEEDS OF SERVICES 1980

SERVICES	2.4	4.8	9.6	56	T-1	Sc1	Sc2	Sc3
MTS (residential)						65	30	5
MTS (business)						65	30	5
Private Line						65	30	5
Mobile						65	30	5
Public Radio								
Commercial and Religious								
Occasional								
CATV Music								
Recording								
Data Transfer			25	70	5			
Batch Processing	70	20	10					
Data Entry	70	20	10					
Remote Job Entry	70	20	10					
Inquiry/Response	70	20	10					
Timesharing	50	20	20	10				
USPS/EMSS	20	10	60	10				
Mailbox	70	20	10					
Administrative Messages	70	20	10					
Facsimile	70	20	10					
Communicating Word Processors	70	20	10					
TWX/Telex	70	20	10					
Mailgram/Telegram/ Money Order	70	20	10					
Point of Sale	70	20	10					
Videotext/Teletext	70	20	10					
Telemonitoring Service	70	20	10					
Secure Voice	20	60	20					
Network								
CATV								
Occasional								
Recording Channel								
Teleconferencing								

TABLE H-5
OPERATING SPEEDS OF SERVICES 1990

SERVICES	2.4	4.8	9.6	56	T-1	Sc1	Sc2	Sc3
MTS (residential)						65	30	5
MTS (business)						65	30	5
Private Line						65	30	5
Mobile						65	30	5
Public Radio								
Commercial and Religious								
Occasional								
CATV Music								
Recording								
Data Transfer			20	50	30			
Batch Processing	20	30	40	10				
Data Entry	20	70	10					
Remote Job Entry	20	70	10					
Inquiry/Response	20	70	10					
Timesharing	20	20	40	20				
USPS/EMSS		10	60	30				
Mailbox	20	70	10					
Administrative Messages	20	70	10					
Facsimile	20	70	10					
Communicating Word Processors	20	70	10					
TWX/Telex	20	70	10					
Mailgram/Telegram/ Money Order	20	70	10					
Point of Sale	20	70	10					
Videotext/Teletext	20	70	10					
Telemonitoring Service	20	70	10					
Secure Voice	20	30	50					
Network								
CATV								
Occasional								
Recording Channel								
Teleconferencing								

TABLE H-6
OPERATING SPEEDS OF SERVICES 2000

SERVICES	2.4	4.8	9.6	56	T-1	Sc1	Sc2	Sc3
MTS (residential)						65	30	5
MTS (business)						65	30	5
Private Line						65	30	5
Mobile						65	30	5
Public Radio								
Commercial and Religious								
Occasional								
CATV Music								
Recording								
Data Transfer			10	20	70			
Batch Processing		30	40	30				
Data Entry	10	20	70					
Remote Job Entry		10	20	70				
Inquiry/Response	10	20	70					
Timesharing		10	20	70				
USPS/EMSS		10	20	70				
Mailbox	10	20	70					
Administrative Messages	10	20	70					
Facsimile	10	20	70					
Communicating Word Processors	10	20	70					
TWX/Telex	10	20	70					
Mailgram/Telegram/ Money Order	10	20	70					
Point of Sale	10	20	70					
Videotext/Teletext	10	20	70					
Telemonitoring Service	10	20	70					
Secure Voice	10	20	70					
Network								
CATV								
Occasional								
Recording Channel								
Teleconferencing								

TABLE H-7
PERCENT OF TRAFFIC NOT SUITABLE FOR CPS

	C	ADDITIONAL KA
MTS (residential)	100	0
MTS (business)	60	0
Private Line	0	0
Mobile	70	0
Public Radio	100	0
Commercial and Religious	0	60
Occasional	0	60
CATV Music	0	60
Recording	0	60
Data Transfer	10	10
Batch Processing	10	10
Data Entry	0	0
Remote Job Entry	0	0
Inquiry/Response	0	0
Timesharing	0	0
USPS/EMSS	50	0
Mailbox	0	20
Administrative Messages	0	20
Facsimile	40	10
Communicating Word Processors	0	20
TWX/Telex	60	10
Mailgram/Telegram/Money Orders	100	0
Point of Sale	10	10
Videotext/Teletext	100	0
Telemonitoring Service	0	0
Secure Voice	0	0
Network	100	0
CATV	100	0
Occasional	100	0
Recording Channel	100	0
Teleconferencing	30	15

TABLE H-8
UNSHARED EARTH STATION COMPOSITE CROSSOVERS

E/S TYPE	CAPACITY	B.R.	WEIGHT	
Large	32.0 Mbps	60 Mbps	10%	10%
Medium	6.3 Mbps	60 Mbps	50%	30%
Medium	6.3 Mbps	15 Mbps		70%
Small	1.5 Mbps	15 Mbps	35%	15%
Small	1.5 Mbps	8 Mbps		30%
Small	1.5 Mbps	SCPC		55%
Mini		SCPC	5%	70%
Mini		SCPC		30%

TABLE H-9
SHARED EARTH STATION COMPOSITE CROSSOVERS

E/S TYPE	CAPACITY	B.R.	WEIGHT	
Large	32 Mbps	60 Mbps	50%	
Medium	32 Mbps	60 Mbps		30%
Medium	32 Mbps	15 Mbps	50%	70%

TABLE H-10. CROSSOVER DISTANCE IN MILES
UNSHARED EARTH STATIONS .999 AVAILABILITY

	2.4	4.8	9.6	56	T1	V1	V2	V3
1980								
C	62	114	252	332	367	4066	3825	3640
KU	123	231	491	631	525	6461	6116	5856
KA	0	0	0	0	0	0	0	0
1990								
C	19	41	127	194	292	2938	2738	2565
KU	51	137	334	440	316	4607	4338	4129
KA	5	15	42	92	205	2006	1824	1659
2000								
C	7	23	61	121	248	2318	2125	1978
KU	28	68	198	283	204	3069	2842	2661
KA	1	1	6	46	118	1283	1134	1007

TABLE H-11. CROSSOVER DISTANCE IN MILES
UNSHARED EARTH STATIONS .995 AVAILABILITY

	2.4	4.8	9.6	56	T1	V1	V2	V3
1980								
C	32	48	115	163	284	2724	2535	2374
KU	98	195	419	525	376	5274	4977	4764
KA	0	0	0	0	0	0	0	0
1990								
C	7	19	45	93	237	2096	1919	1779
KU	41	103	266	359	245	3731	3488	3298
KA	5	15	42	92	204	2003	1820	1655
2000								
C	1	4	17	47	222	1703	1536	1389
KU	20	50	146	222	140	2405	2237	2142
KA	1	1	6	46	117	1279	1130	1004

TABLE H-12. CROSSOVER DISTANCE IN MILES
SHARED EARTH STATIONS .999 AVAILABILITY

	2.4	4.8	9.6	56	T1	V1	V2	V3
1980								
C	692	953	1628	619	185	956	820	688
KU	705	982	1715	682	287	1454	1305	1156
KA	0	0	0	0	0	0	0	0
1990								
C	411	653	1056	535	177	872	758	645
KU	409	649	1048	516	167	805	683	595
KA	481	776	1228	618	173	875	750	652
2000								
C	288	502	854	419	119	564	442	336
KU	287	498	846	410	106	512	390	307
KA	410	713	1023	581	109	579	457	346

TABLE H-13. CROSSOVER DISTANCE IN MILES SHARED EARTH STATIONS .995 AVAILABILITY

	2.4	4.8	9.6	56	T1	V1	V2	V3
1980								
C	688	946	1603	601	154	800	689	587
KU	697	965	1667	647	227	1143	1004	862
KA	0	0	0	0	0	0	0	0
1990								
C	402	634	1018	481	123	619	505	400
KU	404	639	1028	493	139	684	671	463
KA	481	775	1227	618	171	870	745	647
2000								
C	289	503	856	421	121	575	453	344
KU	283	490	832	393	82	415	303	224
KA	409	713	1022	579	108	574	452	341

TABLE H-14
CPS SATELLITE TRAFFIC
(TRANSPONDERS)

SERVICES	YEAR		
	1980	1990	2000
VOICE			
MTS (residential)	0.0	0.0	0.0
MTS (business)	0.5	6.7	35.5
Private Line	0.4	10.1	64.4
Mobile	0.0	0.0	0.3
Public Radio	0.0	0.0	0.0
Commercial and Religious	0.0	0.0	0.1
Occasional	0.0	0.0	0.1
CATV Music	0.0	0.0	0.0
Recording	0.0	0.0	0.0
TOTAL	0.9	16.8	100.4
DATA			
Data Transfer	0.0	0.4	1.6
Batch Processing	0.1	1.1	3.0
Data Entry	16.1	102.2	219.9
Remote Job Entry	0.4	11.6	31.0
Inquiry/Response	0.2	5.3	19.6
Timesharing	0.1	1.4	3.7
USPS/EMSS	0.0	0.4	1.8
Mailbox	0.0	0.8	2.2
Administrative Messages	3.9	65.6	221.5
Facsimile	0.5	4.1	6.5
Communicating Word Processors	0.0	0.5	2.1
TWX/Telex	0.0	0.1	0.1
Mailgram/Telegram/Money Orders	0.0	0.0	0.0
Point of Sale	0.1	6.5	12.5
Videotext/Teletext	0.0	0.0	0.0
Telemonitoring Service	0.0	0.0	0.1
Secure Voice	0.0	0.3	3.3
TOTAL	21.5	200.2	528.8
VIDEO			
Network	0.0	0.0	0.0
CATV	0.0	0.0	0.0
Occasional	0.0	0.0	0.0
Recording Channel	0.0	0.0	0.0
Teleconferencing	0.3	52.2	109.1
TOTAL	0.3	52.2	109.1

APPENDIX I
KA-BAND CPS SATELLITE FORECAST

I.1 INTRODUCTION

The Ka-band CPS Satellite Forecast represents the total amount of traffic addressable by a Ka-band (30/20 GHz) CPS satellite system. Two types of satellite systems were considered. One had unshared earth stations located directly on (or very close) to the customer's own premises. For example, on the roof or in an adjacent parking lot. The Western Union survey (see Appendix D) indicated that very few businesses would have a physical problem with locating such an earth station. The other type of system included shared earth stations as well as the unshared type. For example, an industrial park may share a system located near the center with links provided to the various offices by microwave or cable. Two types of availability levels were considered for each of the above system configurations: .995 and .999.

I.2 METHODOLOGY

To derive the addressable Ka-band CPS, it is necessary to begin with the net long haul (see Appendix E). A series of steps must then be performed reducing traffic for various reasons and making comparisions of the crossover due to various configurations and availabilities. The assumption is made that Ka-band CPS traffic will be all digital. This is based on trends to integrate networks totally. The following steps were performed to determine this traffic (see Figure I-1).

I.2.1 Remove Traffic Due to Satellite Constraints

Unacceptable user and application characteristics refer to usage and technical considerations which play a part in determining the suitability of a particular application for implementation on a satellite transmission system (see Table H-1). Among the qualification criteria evaluated in determining satellite implementation suitability were the following:

a. Satellite delay

What is the ability of an application to tolerate a 600 millisecond delay caused by transmission via satellite? In data applications, this represents the delay between sending a block of information and the acknowledgement of its correct reception.

b. Accommodation of satellite delay

What effect will the cost and required technology necessary to overcome some satellite delay problems have on demand? Included are the costs of software conversion or special equipment, the projection of their availability and ease of implementation.

c. Multipoint signal distribution

What are the requirements of each application for broadcast-type signal distribution? The C-band CONUS coverage easily accommodate multipoint requirements such as are associated with the Network Video application, while Ku-band implementation of multipoint distribution requires a separate half channel for each additional drop. (the Ka-band system model is a point-to-point system, not adaptable to broadcast services.)

d. Urgency of message delivery

How tolerant will users be to service interruptions and outages in excess of that experienced on terrestrial transmission media such as the public switched network? Movement to higher transmission frequencies is accompanied by the potential for lower levels of service availability. The impact of reduced availability varies with each application.

e. Miscellaneous characteristics

Several minor service considerations were also evaluated. They included: joint use of existing facilities, which may cause facility requirements to reflect the principal usage rather than the subordinate usage; and, insufficient traffic volume of a specific application to justify special communications facilities.

Quantification of these qualifying criteria included several conditions. Some were fundamental to the separation of satellite and terrestrial traffic (satellite delay), some were necessary to separate different forms of satellite transmission (multipoint signal distribution), and some were time oriented (accommodation of satellite delay). Each of the 31 service applications were evaluated for each characteristic in current terms (1980) and for the year 2000, based on trends established by judgement and analysis. Intermiediate years also were evaluated if a significant change in trend was anticipated. A factor was established for each criterion for 1980 and 2000 which defined the proportion of market demand associated with a particular service application that could tolerate the requirements of the criterion. The individual factors derived for each criterion were consolidated into a composite qualifying factor and applied to the net long haul market demand for each application and each year of the 1980-2000 time span by computer modelling techniques. This completed the first step.

I.2.2 Remove Traffic Lost Because of Plant in Place

There exists across the United States a tremendous investment in existing plant in place. Such things s AT&T's and Western Union's extensive microwave systems were largely installed several years ago. Once this plant is installed, it becomes a sunk cost. The marginal cost is the cost of maintaining the system. This is the true cost which satellite systems must compete. As competition increases, companies will compete not so much on tariff basis but on a service basis, for example, a voice grade line New York to Los Angeles. Terrestrial systems will tend to underbid their true cost of offering the service in order to cover the cost of a maintaining their present system and covering some of the sunk cost.

As the marginal cost of maintaining the plant in place increases, as the equipment becomes older, and the cost of providing service by satellite becomes cheaper, a higher percentage of the market will be captured by satellites. This is reflected in the percent of traffic removed because of plant in place (see Table H-2). These percentages were obtained by consulting tariff experts and engineers. The major impact was expected to be on voice since the current plant in place was established to mainly handle this type of traffic. The percent of

data to remove was estimated by using the percent of data which uses voice facilities times the percent of voice traffic to remove because of plant in place (see Appendix E).

I.2.3 Reduce Traffic Because of Time Zone Considerations

Peak hour traffic does not consider the different time zones within the continental United States. For instance, if the peak hour for traffic occurs at 2:00 p.m., it is calculated as 2:00 p.m. across the United States. If the satellite system has sufficient compatability, it may be reconfigured and the antennas reshaped to take advantage of the different time zones. An analysis of this affect and the impact on system traffic was performed by Western Union under a previous contract to Motorola (NASA Contract NAS-3-22895). In summary, it was found that a system may be designed for 13 percent less traffic if the system takes advantage of the various time zones. The time zones for the continental United States are shown in Figure H-2. Figure H-3 shows peak hour traffic curve after time zones were considered (note: the traffic number refers to the Motorola study not the current study).

Other aspects of modifying the peak hour were also reviewed such as seasonal variations or the effect of future population shifts. Seasonal variations were found to have spikes or certain days such as Christmas or tax time which were not sustained enough to justify a larger system. The effect of the population shift on traffic was also found to be insignificant. Figure H-4, from the Motorola study, shows this effect.

I.2.4 Remove Traffic not Suitable for Ka-band CPS Transmission

Not all traffic was suitable for inclusion in a Ka-band CPS satellite system. There were several considerations as to the percentage of raffic to be removed. First broadcast applications were considered difficult if not impossible for a CPS system and were largely removed.

Private homes would have very little communication and not use a CPS system so traffic generated there, such as residential message toll service was removed.

In addition, a great deal of interbusiness traffic would be between companies not on the CPS system and therefore should not be included as addressable. In addition, because of the beam size and the multiple use of the Ka-band, an additional amount of traffic was removed. Table H-7 shows the percentages of traffic removed because it was not suitable for Ka-band CPS transmission.

I.2.5 Convert Into Transponders

Up to this point voice, data and video were all carried in unique units; half voice circuits for voice, terabits for data and transponders for video. In order to project the net addressable CPS traffic and the number of satellites this service requires, it was necessary to convert these units into a common unit, transponders.

It was assumed that CPS traffic would be entirely digital. This was based on the nature of CPS, mostly intra company and to a large extent digital to begin with. The following steps were performed to convert the various units to transponders.

I.2.5.1 Voice

To convert half voice circuits into transponders required two steps. The initial step was to determine the number of bits required to transmit a half-voice circuit. Relying on our engineering analysis of future trends, the following number of bits were determined to be needed to code a half-voice circuit.

KBPS PER HALF-VOICE CIRCUIT

1980	1990	2000
64	32	24

These are typical of the number of bits it will take to encode a half-voice circuit. While it has been shown possible to encode a half-voice circuit in as far as 16 Kbps (perhaps even less), the typical circuit today uses 64 Kbps. By 1990 this typical is expected to decline to 32 Kbps. By 2000 a mixture of 50 percent

encoded at 32 Kbps and 50 percent at 16 Kbps is foreseen. Using these typical rates the number of bits needed to transmit the voice traffic was calculated.

The second step to convert half-voice circuits into transponders was to divide by the amount of data throughput a CPS transponder could handle. These numbers were found as explained below in the data section.

I.2.5.2 Data

To convert terabits into transponders it was necessary to calculate the number of bits which a CPS transponder could handle. An analysis was made considering that the typical CPS earth station would be small and that several would utilize the same transponder simultaneously. As more earth stations utilize the same transponder, the overhead required increases and the efficiency declines. Using this, the following data rates were found to be typical.

MBPS PER TRANSPONDER

1980	1990	2000
36	52.5	52.5

I.2.5.3 Video

The number of transponders needed for video was the basic unit established for those services in producing the baseline. Such things as compression of video signals and the ability to transmit more than one signal over a transponder were considered there. Therefore, no adjustments were needed to convert the video services to CPS transponders (in addition, all video services except teleconferencing are eliminated because of the very nature of CPS).

I.2.6 Distribute Demand to All Real and Artificial SMSAs

In order to distribute the demand for transponders among the 313 SMSAs and the 48 artificial SMSAs, it was necessary to use the market distribution model (see

Appendix C). Table H-3 shows the files and weights used to perform this distribution.

I.2.7 Segment Services into Various Operating Speeds

The next step is to segment the thirty-one services into the various operating speeds. This analysis done by engineers reviewed such things as the trend toward more high speed data. Services involving a great deal of CPU to CPU traffic which would normally go over high volume circuits were shown as such, for instance, data transfer. Slower services, such as data entry, were segmented into the slower speeds.

I.2.8 Trunking/Ka-band CPS Crossover Comparison

Four comparisons of the Ka-band crossover (.995 unshared, .999 unshared, .995 shared/unshared, .999 shared/unshared) were made with trunking next. Some traffic which economically would go trunking would likely be included on a Ka-band CPS system as secondary traffic once the system was installed. The most likely candidate would be business message toll service. After establishing an intrabusiness CPS system based on cost effectiveness a company would likely include some of the intrabusiness telephone service. For the same reason, it was decided that wherever the trunking/Ka-band CPS crossover favored trunking 10 percent of the traffic would be addressable by Ka band CPS.

I.2.9 Consider Traffic Differences Due to Availability

The acceptable level of availability for a service varies widely among users and depends upon the applications utilized and the importance of those applications in the user's business operations. For example, a 300 baud service used for time sharing is normally more sensitive to interruptions than the same service used for Administrative data traffic. Similarly, a time-share user may be willing to wait a considerable length of time for a circuit to be repaired but cannot tolerate a 10 second interruption. On the other hand, a stockbroker may easily tolerate a one minute interruption but cannot afford a half hour outage, because the telephone system in this case is an integral part of his business operations.

For the purpose of this study the following parameters were used to define the levels of availability.

SUMMARY OF AVAILABILITIES

Availability	Percent Available	Availability Outage Per Year	Extended Frequency (Outage/Day)
High	99.9	9 Hours	1.5 Minutes
Medium	99.5	46.5 Hours	7.6 Minutes
Low	Less than 99.5	---	---

From a carrier's point of view, availability of a service is a discretely quantifiable design criterion, but for most users it is a qualitative measure of the service performance. Users (telecommunications managers) normally measure the reliability or quality of a service by the frequency of complaints they get from their end users (management and clerical employees). It is difficult for them to define required reliability standards for each of the several applications the service is or will be used for. Futheremore, from the users' point of view, it is the carrier who is responsible for the end-to-end availability of a service.

Previous user surveys, including the one conducted by Western Union, revealed that most users currently use the same network/serice for their voice and data communications needs. Furthermore, the same service is being used for several voice and data applications among which are certain applicatins that could easily tolerate a lower availabiity than that of the present service. Most users were unable to assess their required circuit availability levels by application and even more hesitant about projecting the effect of availability changes. Using our survey and other sources we came to the following conclusions:

a. Primarily, voice and video services support high reliability traffic and cannot be easily accommodated by a lower reliability transmission medium.

b. A large proportion of data traffic which is currently carried over high reliability, slow speed network systems/services may be delivered to a lower reliabiity system.

c. Telecommunicatins systems and services are becoming more and more important to users' business operations. Users, concerned about their escalating telecommunication costs, will use lower reliabiity service to reduce those costs but will normally maintain a considerable portion of their high reliability service. This high reliability serice may be maintained to provide a backup for the lower reliability service, in addition to carrying their high reliability service.

c. Telecommunicatins systems and services are becoming more and more important to users's business operations. Users, concerned about their escalating telecommunication costs, will use lower reliability service to reduce those costs but will normally maintain a considerable portion of their high reliability service. This high reliability service may be maintained to provide a backup for the lower reliability service, in addition to carrying their high reliability service.

From the user's point of view, the acceptable level of availability is a very subjective and qualitative issue. Most user's are unable to define their service availability requirements by application and tend to employ a high reliability service for both their high and low reliability traffic demand. Our conclusion from this was that the difference in .995 and .999 availability was not as critical as many thought. A factor of ten percent was applied across all services, therefore, to quantify this somewhat subjective factor.

I.2.10 Applying the Ka-band CPS Crossovers

The next step was to apply the crossover for each speed and each service to the remaining traffic using MDM. This was done for each of the four configurations. Aggregating the traffic from the various speeds yield the net addressable Ka band CPS traffic for that service and for that particular configuration.

I.2.11 Divide Services by User Group

Having estimated the addressable Ka band CPS traffic it was necessary to determine which sectors in the U.S. economy are potential users of CPS and

project a level of demand for each. Four user categories were appropriate for this determination: Business, Government, Institutions and Private. Industry economic data, operating characteristics and telecommunications demand were analyzed on a individual basis in order to determine trends in each sector. Information for this analysis was obtained from the user survey (see Appendix D) and secondary research.

The telecommunications user population was grouped into fourteen industrial and one non-industrial (residential users) sector utilizing the Standard Industry Classification (SIC) system. As indicated below, these industry sectors were further grouped into the four user categories based upon the primary function of each in the U.S. economy and also its operating characteristics.

USER CATEGORY DEFINITION

USER CATEGORY	INDUSTRY SECTOR	SIC CODE
Business	Manufacturing (Discrete and Process)	20-39
	Wholesale Distribution	50-51
	Retail Distribution	52-59
	Finance and Banking	60-67
	Insurance	63-64
	Transportation	40-47
	Utilities	48-49
	Professional Business Service	73-89
	Other (Miscellaneous Businesses)	
Government	Federal	91-97, 43
	State and Local	91-97
Institution	Education	82
	Health Care	80
	Other Membership Organizations	83,86
*Private	U.S. Population (Households) not residing	-
*Non-Industrial Sector		

Using the above classifications with the information obtained from our survey and secondary resources we analyzed the CPS traffic pattern among the 31 services (Note: The traffic pattern is indicated for all services, even those with no CPS traffic, for example residential message toll service). This is presented Table I-1.

.2.12 Ka-Band CPS Satellite Traffic Configuration Reports

These are a series of four reports (Tables I-2-5) showing the net addressable traffic for the various Ka-band CPS configurations (availability and type of earth stations). The first column gives the name of the service forecasted. At the end of each group of services, voice, data and video subtotals are given. The next three columns present the traffic forecast in transponders. No data are given for 1980 because of the amount of addressable traffic was insignificant and no Ka technology existed at the time.

I.2.13 Ka-band CPS Satellite Traffic Mileage Reports

These are a series of 24 reports (Tables I-6-29) showing the net addressable traffic for the various Ka-band configurations (availability and type of earth station) by the mileage band it is transmitted. The MDM provided the capability of distributing traffic volumes as a function of distance. SMSA's less than 40 miles apart are not included as part of the air line miles. SMSA longitues and latitudes are identified in terms of V & H coordinates and maintained as a part of the MDM, which permit the calculation of route distances.

Six airline mileage bands were established to develop a distribution of traffic by distance transmitted. The structure of the six mileage bands was designed to provide practical and usable mileage groupings that would satisfy the requirements of the study. For ease of analysis the groupings were similar though not identical to AT&T Long Lines mileage bands as listed below.

MILEAGE BAND CATEGORIES

Report	Minimum Distance Transmitted (Miles)	Maximum Distance Transmitted (Miles)
1	1	40
2	41	150
3	151	500
4	501	1000
5	1001	2000
6	2001	---

Each of the four configurations has the six mileage band reports. The first column gives the name of the service forecasted. At the end of each group of services, voice, data and video subtotals are given. The next three columns present the traffic forecast in transponders.

I.2.14 Ka Band CPS Satellite User Class Reports

These are a series of 16 reports (Tables I-30-45) showing the net addressable traffic for the various Ka band CPS configurations (availabiity and type of earth stations) by the user class (see Table I-1). The first column gives the name of the service. At the end of each group of services, voice data and video a subtotal is given. The next three columns present the traffic forecast in transponders. The user classes for this study are as follows:

Business
Government
Institutional
Private

Each of the four configurations has the four user reports. The first column on these reports gives the name of the service forecasted. At the end of each group of services, voice data and video subtotals are given.

1.2.15 Ka Band CPS Satellite Traffic Regional Reports

These are a series of thiry-six reports (Tables I-46-81) showing the net addressable traffic for the various Ka band CPS configurations (availability and type of earth station) by region.

The Market Distributions Model (MDM) has assigned market demand values to each of the 361 SMSA's (313 real and 48 artificial) for each of the service categories based on the usage profiles of each category. The MDM has calculated market values for each of the routes connecting the 361 SMSA's using formulas internal to the model. By combining the route market values and the geographical areas, potential region/demand relationships can be interpreted for 1990 and 2000.

Nine geographical areas were selected in conformance with Department of Commerce standards and as set forth in Rand McNally statistical work. The selected regions are shown below and in Figure I-2.

a. New England
b. Middle Atlantic
c. South Atlantic
d. East North Central
e. West North Central
f. East South Central
g. West South Central
h. Pacific

The 361 SMSA's were assigned to the appropriate regions. (SMSA's which crossed regional boundaries were assigned to the region where the greatest portion of its population resided.) The traffic market values for each route were distributed among the 361 SMSA's by the MDM. Appropriate weight was given to each region on the basis of traffic originating and terminating at each SMSA. This meant that the market demand for traffic which crossed regional boundaries was split between the applicable regions and that the market demand for traffic which both originated and terminated within a particular region was credited solely to that region.

Each of the four configurations has nine regional reports. The first column gives the name of the service forecasted. At the end of each group of services, voice data and video subtotals are given. The next three columns present the traffic forecast in transponders.

I.2.16 Ka-band CPS Satellite Traffic User/Regional Reports

These are a set of four reports (Tables I-82-85) showing the net addressable traffic for the various Ka-band CPS configurations (availability and type of earth station) by region and user type. The information for this report was derived from the Ka-band CPS satellite traffic regional report explained above. The amount of traffic for each user, for each region, for each year is indicated.

I.2.17 Ka-band CPS Satellite Traffic User/Mileage Reports

These are a set of four reports (Tables I-86-89) showing the net addressable traffic for the various Ka-band CPS configurations (availability and type of earth station) by mileage and user type. The information for this report was derived from the Ka-band CPS satellite traffic regional report explained above. The amount of traffic for each user, for each mileage band, for each year is indicated.

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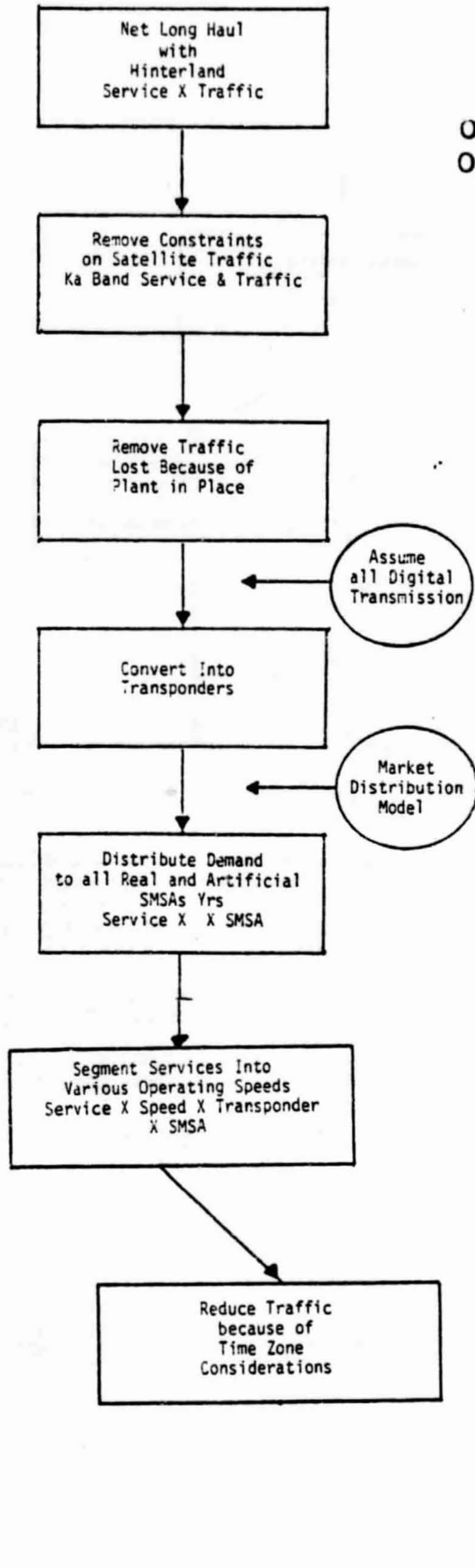

FIGURE I-1. KaBAND SATELLITE FORECAST FLOWCHART

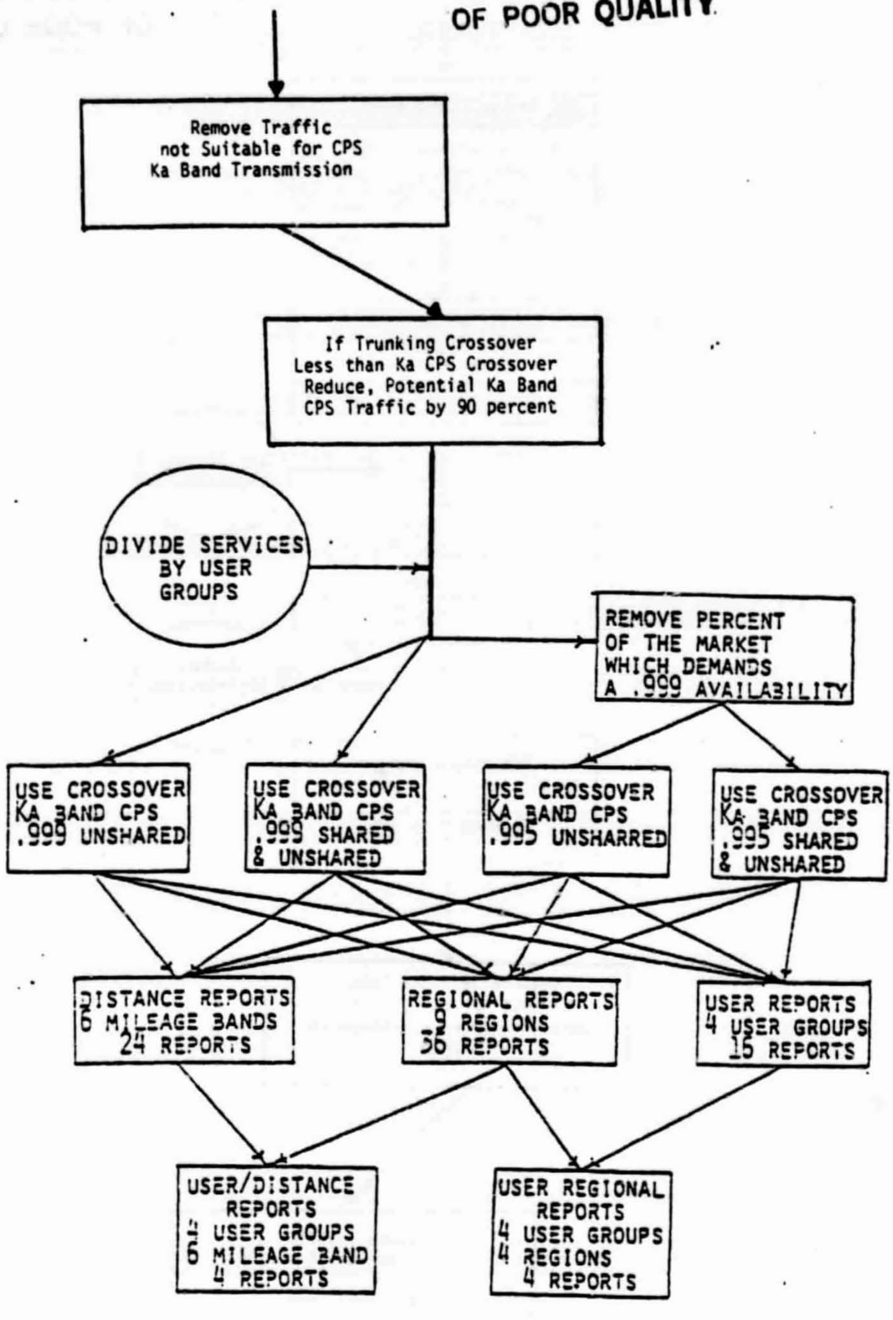

FIGURE I-1. KaBAND SATELLITE FORECAST FLOWCHART (CONTINUED)

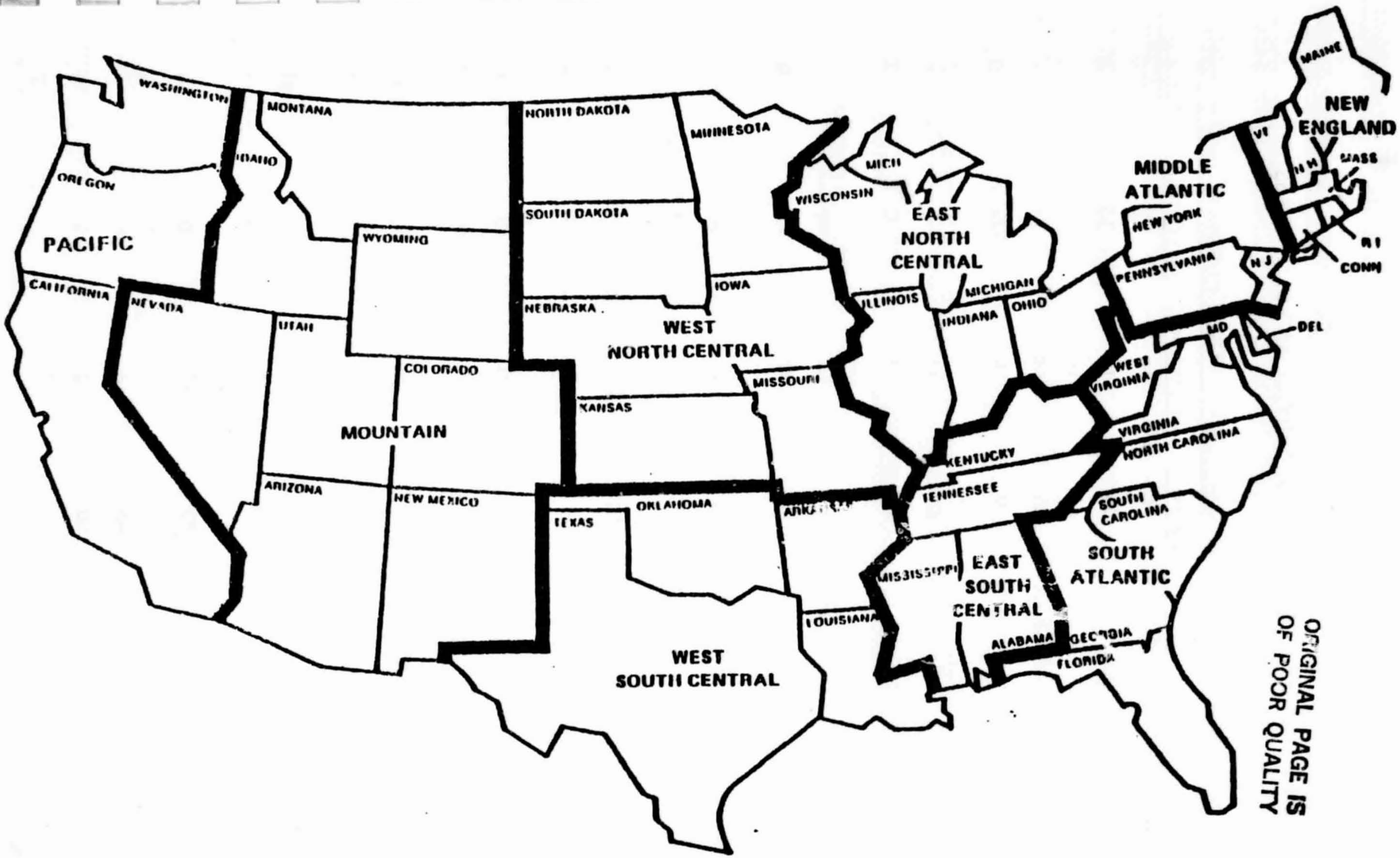

FIGURE I-2. GEOGRAPHICAL TRAFFIC REGIONS

TABLE I-1. PERCENT OF TRAFFIC BY SERVICE AND USER CLASS

	USER CLASS			
SERVICE	Business	Institutional	Government	Private
MTS (Residential)	0	0	0	100
MTS (Business	50	15	35	0
Private Line	65	10	25	0
Mobile	80	5	15	0
Public Radio	0	0	100	0
Commercial and Religious	80	20	0	0
Occasional	80	20	0	0
CATV Music	100	0	0	0
Recording	100	0	0	0
Data Transfer	40	20	40	0
Batch Processing	50	30	20	0
Data Entry	45	15	35	5
Remote Job Entry	50	30	20	0
Inquiry/Response	65	10	20	5
Timesharing	40	20	40	0
USPS/EMSS	60	30	10	0
Mailbox	70	10	20	0
Administrative Messages	40	20	40	0
Facsimile	60	10	30	0
Communicating Word Processors	70	5	25	0
TWX/Telex	55	15	30	0
Mailgram/Telegram/Money Orders	40	25	10	25
Point of Sale	85	5	10	0
Videotext/Teletext	45	15	15	25
Telemonitoring Service	35	5	25	35
Secure Voice	20	0	80	0
Data				
Network	90	10	0	0
CATV	90	10	0	0
Occasional	90	10	0	0
Recording Channel	100	0	0	0
Teleconferencing	60	10	30	0

TABLE I-2. KA-BAND CPS SATELLITE TRAFFIC AVAIL=.999, UNSHARED EARTH STATIONS (TRANSPONDERS)

SERVICE	YEAR 1980	1990	2000
VOICE			
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.8	7.1
PRIVATE LINE		1.8	20.5
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
TOTAL		2.6	27.7
DATA			
DATA TRANSFER		0.3	1.3
BATCH PROCESSING		0.9	2.4
DATA ENTRY		102.2	219.9
REMOTE JOB ENTRY		11.6	31.0
INQUIRY/RESPONSE		5.3	19.6
TIMESHARING		1.4	3.7
USPS/EMSS		0.4	1.8
MAILBOX		0.5	1.5
ADMINISTRATIVE MESSAGES		44.0	149.1
FACSIMILE		3.1	5.0
COMMUNICATING WORD PROCESSORS		0.3	1.4
TWX/TELEX		0.1	0.1
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		5.3	10.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.1
SECURE VOICE		0.3	3.3
TOTAL		175.7	450.2
VIDEO			
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		34.9	72.8
TOTAL		34.9	72.8

TABLE I-3. KA-BAND CPS SATELLITE TRAFFIC
AVAIL=.999, SHARED/UNSHARED EARTH STATIONS
(TRANSPONDERS)

SERVICE	YEAR		
VOICE	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		4.1	21.7
PRIVATE LINE		10.0	63.0
MOBILE		0.0	0.3
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
TOTAL		14.2	85.1
DATA			
DATA TRANSFER		0.3	1.3
BATCH PROCESSING		0.9	2.4
DATA ENTRY		102.2	219.9
REMOTE JOB ENTRY		11.6	31.0
INQUIRY/RESPONSE		5.3	19.6
TIMESHARING		1.4	3.7
USPS/EMSS		0.4	1.8
MAILBOX		0.5	1.5
ADMINISTRATIVE MESSAGES		44.0	149.1
FACSIMILE		3.1	5.0
COMMUNICATING WORD PROCESSORS		0.3	1.4
TWX/TELEX		0.1	0.1
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		5.3	10.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.1
SECURE VOICE		0.3	3.3
TOTAL		175.7	450.2
VIDEO			
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		34.9	72.8
TOTAL		34.9	72.8

TABLE I-4. KA-BAND CPS SATELLITE TRAFFIC AVAIL=.995, UNSHARED EARTH STATIONS (TRANSPONDERS)

SERVICE	YEAR		
VOICE	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.7	6.4
PRIVATE LINE		1.7	18.5
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
TOTAL		2.4	25.1
DATA			
DATA TRANSFER		0.3	1.2
BATCH PROCESSING		0.8	2.2
DATA ENTRY		91.9	198.0
REMOTE JOB ENTRY		10.4	27.9
INQUIRY/RESPONSE		4.8	17.6
TIMESHARING		1.2	3.4
USPS/EMSS		0.4	1.6
MAILBOX		0.5	1.3
ADMINISTRATIVE MESSAGES		39.6	134.2
FACSIMILE		2.8	4.5
COMMUNICATING WORD PROCESSORS		0.3	1.2
TWX/TELEX		0.1	0.1
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		4.8	9.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.2	2.9
TOTAL		158.2	405.2
VIDEO			
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		31.4	65.5
TOTAL		31.4	65.5

TABLE I-5. KA-BAND CPS SATELLITE TRAFFIC AVAIL=.995, SHARED/UNSHARED EARTH STATIONS (TRANSPONDERS)

SERVICE	YEAR		
VOICE	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		3.7	19.7
PRIVATE LINE		9.1	57.1
MOBILE		0.0	0.3
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
TOTAL		12.9	77.2
DATA			
DATA TRANSFER		0.3	1.2
BATCH PROCESSING		0.8	2.2
DATA ENTRY		91.9	198.0
REMOTE JOB ENTRY		10.4	27.9
INQUIRY/RESPONSE		4.8	17.6
TIMESHARING		1.2	3.4
USPS/EMSS		0.4	1.6
MAILBOX		0.5	1.3
ADMINISTRATIVE MESSAGES		39.6	134.2
FACSIMILE		2.8	4.5
COMMUNICATING WORD PROCESSORS		0.3	1.2
TWX/TELEX		0.1	0.1
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		4.8	9.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.2	2.9
TOTAL		158.2	405.2
VIDEO			
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		31.4	65.5
TOTAL		31.4	65.5

TABLE I-6

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
1 - 40 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.4
PRIVATE LINE		0.1	1.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.6
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.0	0.1
DATA ENTRY		5.8	12.5
REMOTE JOB ENTRY		0.7	1.8
INQUIRY/RESPONSE		0.3	1.1
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.4	8.1
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		9.8	25.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.9	3.9
		1.9	3.9

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KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
41 - 150 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.0
PRIVATE LINE		0.3	3.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.4	4.0
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		15.0	32.2
REMOTE JOB ENTRY		1.7	4.5
INQUIRY/RESPONSE		0.8	2.9
TIMESHARING		0.2	0.5
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		6.4	21.5
FACSIMILE		0.5	0.7
COMMUNICATING WORD PROCESSORS		0.0	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.8	1.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.4
		25.7	65.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.1	10.6
		5.1	10.6

TABLE I-8

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
151 - 500 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	2.2
PRIVATE LINE		0.6	6.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.8	8.6
DATA TRANSFER		0.1	0.4
BATCH PROCESSING		0.3	0.8
DATA ENTRY		32.0	69.0
REMOTE JOB ENTRY		3.6	9.7
INQUIRY/RESPONSE		1.7	6.1
TIMESHARING		0.4	1.2
USPS/EMSS		0.1	0.5
MAILBOX		0.2	0.5
ADMINISTRATIVE MESSAGES		13.8	46.8
FACSIMILE		1.0	1.6
COMMUNICATING WORD PROCESSORS		0.1	0.4
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.7	3.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	1.0
		55.1	141.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		10.9	22.7
		10.9	22.7

TABLE I-9

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
501 - 1000 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.9
PRIVATE LINE		0.5	5.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.7	7.6
DATA TRANSFER		0.1	0.4
BATCH PROCESSING		0.2	0.7
DATA ENTRY		28.0	60.4
REMOTE JOB ENTRY		3.2	8.5
INQUIRY/RESPONSE		1.5	5.4
TIMESHARING		0.4	1.0
USPS/EMSS		0.1	0.5
MAILBOX		0.1	0.4
ADMINISTRATIVE MESSAGES		12.2	41.3
FACSIMILE		0.9	1.4
COMMUNICATING WORD PROCESSORS		0.1	0.4
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.5	2.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.9
		48.4	124.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		9.6	20.1
		9.6	20.1

TABLE I-10

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
1001 - 2100 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.3
PRIVATE LINE		0.3	3.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	4.9
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		17.5	37.7
REMOTE JOB ENTRY		2.0	5.3
INQUIRY/RESPONSE		0.9	3.4
TIMESHARING		0.2	0.6
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		7.6	25.8
FACSIMILE		0.5	0.9
COMMUNICATING WORD PROCESSORS		0.1	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.9	1.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		30.2	77.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.1	12.7
		6.1	12.7

TABLE I-11

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
2100 - MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.3
PRIVATE LINE		0.1	0.8
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.1
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.8	8.2
REMOTE JOB ENTRY		0.4	1.2
INQUIRY/RESPONSE		0.2	0.7
TIMESHARING		0.1	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		1.6	5.5
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.4
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		6.5	16.7
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.3	2.8
		1.3	2.8

TABLE I-12

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
1 - 40 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.2
PRIVATE LINE		0.6	3.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.8	4.8
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.0	0.1
DATA ENTRY		5.8	12.5
REMOTE JOB ENTRY		0.7	1.8
INQUIRY/RESPONSE		0.3	1.1
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.4	8.1
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		9.8	25.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.9	3.9
		1.9	3.9

TABLE I-13

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
41 - 150 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.6	3.1
PRIVATE LINE		1.5	9.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.0	0.0
		2.1	12.4
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		15.0	32.2
REMOTE JOB ENTRY		1.7	4.5
INQUIRY/RESPONSE		0.8	2.9
TIMESHARING		0.2	0.5
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		6.4	21.5
FACSIMILE		0.5	0.7
COMMUNICATING WORD PROCESSORS		0.0	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.8	1.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.4
		25.7	65.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.1	10.6
		5.1	10.6

TABLE I-14

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
151 - 500 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.3	6.7
PRIVATE LINE		3.1	19.5
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		4.4	26.4
DATA TRANSFER		0.1	0.4
BATCH PROCESSING		0.3	0.8
DATA ENTRY		32.0	69.0
REMOTE JOB ENTRY		3.6	9.7
INQUIRY/RESPONSE		1.7	6.1
TIMESHARING		0.4	1.2
USPS/EMSS		0.1	0.5
MAILBOX		0.2	0.5
ADMINISTRATIVE MESSAGES		13.8	46.8
FACSIMILE		1.0	1.6
COMMUNICATING WORD PROCESSORS		0.1	0.4
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.7	3.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	1.0
		55.1	141.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		10.9	22.7
		10.9	22.7

TABLE I-15

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
501 - 1000 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.1	6.0
PRIVATE LINE		2.7	17.3
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		3.9	23.3
DATA TRANSFER		0.1	0.4
BATCH PROCESSING		0.2	0.7
DATA ENTRY		28.0	60.4
REMOTE JOB ENTRY		3.2	8.5
INQUIRY/RESPONSE		1.5	5.4
TIMESHARING		0.4	1.0
USPS/EMSS		0.1	0.5
MAILBOX		0.1	0.4
ADMINISTRATIVE MESSAGES		12.2	41.3
FACSIMILE		0.9	1.4
COMMUNICATING WORD PROCESSORS		0.1	0.4
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.5	2.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.9
		48.4	124.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		9.6	20.1
		9.6	20.1

TABLE I-16

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
1001 - 2100 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.7	3.8
PRIVATE LINE		1.7	11.0
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.5	14.9
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		17.5	37.7
REMOTE JOB ENTRY		2.0	5.3
INQUIRY/RESPONSE		0.9	3.4
TIMESHARING		0.2	0.6
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		7.6	25.8
FACSIMILE		0.5	0.9
COMMUNICATING WORD PROCESSORS		0.1	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.9	1.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		30.2	77.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.1	12.7
		6.1	12.7

TABLE I-17

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
2100 - MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	0.9
PRIVATE LINE		0.4	2.4
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.6	3.3
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.8	8.2
REMOTE JOB ENTRY		0.4	1.2
INQUIRY/RESPONSE		0.2	0.7
TIMESHARING		0.1	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		1.6	5.5
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.4
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		6.5	16.7
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.3	2.8
		1.3	2.8

TABLE I-18

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
1 - 40 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.4
PRIVATE LINE		0.1	1.1
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.4
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.0	0.1
DATA ENTRY		5.2	11.2
REMOTE JOB ENTRY		0.6	1.6
INQUIRY/RESPONSE		0.3	1.0
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.2	7.3
FACSIMILE		0.2	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		8.8	22.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.7	3.5
		1.7	3.5

TABLE I-19

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
41 - 150 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.9
PRIVATE LINE		0.2	2.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.3	3.7
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.3
DATA ENTRY		13.5	29.0
REMOTE JOB ENTRY		1.5	4.1
INQUIRY/RESPONSE		0.7	2.6
TIMESHARING		0.2	0.5
USPS/EMSS		0.1	0.2
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		5.7	19.4
FACSIMILE		0.4	0.6
COMMUNICATING WORD PROCESSORS		0.0	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.7	1.4
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.4
		23.1	59.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		4.6	9.5
		4.6	9.5

TABLE I-20

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
151 - 500 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	2.0
PRIVATE LINE		0.5	5.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.7	7.8
DATA TRANSFER		0.1	0.4
BATCH PROCESSING		0.2	0.7
DATA ENTRY		28.8	62.1
REMOTE JOB ENTRY		3.3	8.7
INQUIRY/RESPONSE		1.5	5.5
TIMESHARING		0.4	1.1
USPS/EMSS		0.1	0.5
MAILBOX		0.2	0.4
ADMINISTRATIVE MESSAGES		12.4	42.1
FACSIMILE		0.9	1.4
COMMUNICATING WORD PROCESSORS		0.1	0.4
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.5	2.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.9
		49.6	127.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		9.8	20.5
		9.8	20.5

TABLE I-21

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
501 - 1000 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.8
PRIVATE LINE		0.5	5.1
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.6	6.9
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.6
DATA ENTRY		25.2	54.3
REMOTE JOB ENTRY		2.9	7.7
INQUIRY/RESPONSE		1.3	4.8
TIMESHARING		0.3	0.9
USPS/EMSS		0.1	0.4
MAILBOX		0.1	0.4
ADMINISTRATIVE MESSAGES		11.0	37.2
FACSIMILE		0.8	1.2
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.3	2.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.8
		43.5	111.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		8.7	18.1
		8.7	18.1

TABLE I-22

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
1001 - 2100 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.1
PRIVATE LINE		0.3	3.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.4	4.4
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		15.8	33.9
REMOTE JOB ENTRY		1.8	4.8
INQUIRY/RESPONSE		0.8	3.0
TIMESHARING		0.2	0.6
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		6.9	23.3
FACSIMILE		0.5	0.8
COMMUNICATING WORD PROCESSORS		0.1	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.8	1.6
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.5
		27.2	69.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.5	11.4
		5.5	11.4

TABLE I-23

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
2100 - MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.3
PRIVATE LINE		0.1	0.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA. SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.4	7.4
REMOTE JOB ENTRY		0.4	1.0
INQUIRY/RESPONSE		0.2	0.7
TIMESHARING		0.0	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.0
ADMINISTRATIVE MESSAGES		1.5	5.0
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.3
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		5.9	15.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.2	2.5
		1.2	2.5

TABLE I-24

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
1 - 40 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.1
PRIVATE LINE		0.5	3.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.7	4.4
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.0	0.1
DATA ENTRY		5.2	11.2
REMOTE JOB ENTRY		0.6	1.6
INQUIRY/RESPONSE		0.3	1.0
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.2	7.3
FACSIMILE		0.2	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		8.8	22.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.7	3.5
		1.7	3.5

TABLE I-25

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
41 - 150 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.5	2.8
PRIVATE LINE		1.3	8.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.C	0.0
RECORDING		0.0	0.0
		1.9	11.2
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.3
DATA ENTRY		13.5	29.0
REMOTE JOB ENTRY		1.5	4.1
INQUIRY/RESPONSE		0.7	2.6
TIMESHARING		0.2	0.5
USPS/EMSS		0.1	0.2
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		5.7	19.4
FACSIMILE		0.4	0.6
COMMUNICATING WORD PROCESSORS		0.0	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.7	1.4
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.4
		23.1	59.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		4.6	9.5
		4.6	9.5

TABLE I-26

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
151 - 500 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.2	6.1
PRIVATE LINE		2.8	17.7
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		4.0	23.9
DATA TRANSFER		0.1	0.4
BATCH PROCESSING		0.2	0.7
DATA ENTRY		28.8	62.1
REMOTE JOB ENTRY		3.3	8.7
INQUIRY/RESPONSE		1.5	5.5
TIMESHARING		0.4	1.1
USPS/EMSS		0.1	0.5
MAILBOX		0.2	0.4
ADMINISTRATIVE MESSAGES		12.4	42.1
FACSIMILE		0.9	1.4
COMMUNICATING WORD PROCESSORS		0.1	0.4
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.5	2.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.9
		49.6	127.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		9.8	20.5
		9.8	20.5

TABLE I-27

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
501 - 1000 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.0	5.4
PRIVATE LINE		2.5	15.7
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		3.5	21.1
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.6
DATA ENTRY		25.2	54.3
REMOTE JOB ENTRY		2.9	7.7
INQUIRY/RESPONSE		1.3	4.8
TIMESHARING		0.3	0.9
USPS/EMSS		0.1	0.4
MAILBOX		0.1	0.4
ADMINISTRATIVE MESSAGES		11.0	37.2
FACSIMILE		0.8	1.2
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.3	2.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.8
		43.5	111.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		8.7	18.1
		8.7	18.1

TABLE I-28

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
1001 - 2100 MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.7	3.5
PRIVATE LINE		1.6	10.0
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.3	13.5
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		15.8	33.9
REMOTE JOB ENTRY		1.8	4.8
INQUIRY/RESPONSE		0.8	3.0
TIMESHARING		0.2	0.6
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		6.9	23.3
FACSIMILE		0.5	0.8
COMMUNICATING WORD PROCESSORS		0.1	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.8	1.6
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.5
		27.2	69.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.5	11.4
		5.5	11.4

ORIGINAL PAGE IS OF POOR QUALITY

TABLE I-29

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
2100 - MILES

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.8
PRIVATE LINE		0.4	2.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	3.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.4	7.4
REMOTE JOB ENTRY		0.4	1.0
INQUIRY/RESPONSE		0.2	0.7
TIMESHARING		0.0	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.0
ADMINISTRATIVE MESSAGES		1.5	5.0
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.3
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		5.9	15.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.2	2.5
		1.2	2.5

TABLE I-30

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
BUSINESS

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.4	3.5
PRIVATE LINE		1.2	13.3
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.6	17.0
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.4	1.2
DATA ENTRY		46.0	99.0
REMOTE JOB ENTRY		5.8	15.5
INQUIRY/RESPONSE		3.5	12.7
TIMESHARING		0.5	1.5
USPS/EMSS		0.3	1.1
MAILBOX		0.4	1.0
ADMINISTRATIVE MESSAGES		17.6	59.7
FACSIMILE		1.9	3.0
COMMUNICATING WORD PROCESSORS		0.2	1.0
TWX/TELEX		0.0	0.1
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		4.5	8.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.7
		81.3	205.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		20.9	43.7
		20.9	43.7

TABLE I-31

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
INSTITUTION

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.1
PRIVATE LINE		0.2	2.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.3	3.1
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.3	0.7
DATA ENTRY		15.3	33.0
REMOTE JOB ENTRY		3.5	9.3
INQUIRY/RESPONSE		0.5	2.0
TIMESHARING		0.3	0.7
USPS/EMSS		0.1	0.5
MAILBOX		0.1	0.1
ADMINISTRATIVE MESSAGES		8.8	29.8
FACSIMILE		0.3	0.5
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		29.5	77.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.5	7.3
		3.5	7.3

TABLE I-32

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
GOVERNMENT

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	2.5
PRIVATE LINE		0.5	5.1
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.7	7.6
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.2	0.5
DATA ENTRY		35.8	77.0
REMOTE JOB ENTRY		2.3	6.2
INQUIRY/RESPONSE		1.1	3.9
TIMESHARING		0.5	1.5
USPS/EMSS		0.0	0.2
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		17.6	59.7
FACSIMILE		0.9	1.5
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	1.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.2	2.6
		59.5	155.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		10.5	21.8
		10.5	21.8

TABLE I-33

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
PRIVATE

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.0
PRIVATE LINE		0.0	0.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.0	0.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.0
DATA ENTRY		5.1	11.0
REMOTE JOB ENTRY		0.0	0.0
INQUIRY/RESPONSE		0.3	1.0
TIMESHARING		0.0	0.0
USPS/EMSS		0.0	0.0
MAILBOX		0.0	0.0
ADMINISTRATIVE MESSAGES		0.0	0.0
FACSIMILE		0.0	0.0
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.0	0.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	C.0
SECURE VOICE		0.0	0.0
		5.4	12.0
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		0.0	0.0
		0.0	0.0

TABLE I-34

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
BUSINESS

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		2.1	10.9
PRIVATE LINE		6.5	41.0
MOBILE		0.0	0.3
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		8.6	52.1
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.4	1.2
DATA ENTRY		46.0	99.0
REMOTE JOB ENTRY		5.8	15.5
INQUIRY/RESPONSE		3.5	12.7
TIMESHARING		0.5	1.5
USPS/EMSS		0.3	1.1
MAILBOX		0.4	1.0
ADMINISTRATIVE MESSAGES		17.6	59.7
FACSIMILE		1.9	3.0
COMMUNICATING WORD PROCESSORS		0.2	1.0
TWX/TELEX		0.0	0.1
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		4.5	8.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.7
		81.3	205.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		20.9	43.7
		20.9	43.7

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
INSTITUTION

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.6	3.3
PRIVATE LINE		1.0	6.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
CCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.6	9.6
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.3	0.7
DATA ENTRY		15.3	33.0
REMOTE JOB ENTRY		3.5	9.3
INQUIRY/RESPONSE		0.5	2.0
TIMESHARING		0.3	0.7
USPS/EMSS		0.1	0.5
MAILBOX		0.1	0.1
ADMINISTRATIVE MESSAGES		8.8	29.8
FACSIMILE		0.3	0.5
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		29.5	77.6
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.5	7.3
		3.5	7.3

TABLE I-36

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
GOVERNMENT

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.4	7.6
PRIVATE LINE		2.5	15.8
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		3.9	23.4
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.2	0.5
DATA ENTRY		35.8	77.0
REMOTE JOB ENTRY		2.3	6.2
INQUIRY/RESPONSE		1.1	3.9
TIMESHARING		0.5	1.5
USPS/EMSS		0.0	0.2
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		17.6	59.7
FACSIMILE		0.9	1.5
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	1.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.2	2.6
		59.5	155.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		10.5	21.8
		10.5	21.8

TABLE I-37

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
PRIVATE

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.0
PRIVATE LINE		0.0	0.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.0	0.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.0
DATA ENTRY		5.1	11.0
REMOTE JOB ENTRY		0.0	0.0
INQUIRY/RESPONSE		0.3	1.0
TIMESHARING		0.0	0.0
USPS/EMSS		0.0	0.0
MAILBOX		0.0	0.0
ADMINISTRATIVE MESSAGES		0.0	0.0
FACSIMILE		0.0	0.0
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.0	0.0
VIDEOTEXT TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		5.4	12.0
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		0.0	0.0
		0.0	0.0

TABLE I-38

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
BUSINESS

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	3.2
PRIVATE LINE		1.1	12.0
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.4	15.4
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.4	1.1
DATA ENTRY		41.4	89.1
REMOTE JOB ENTRY		5.2	13.9
INQUIRY/RESPONSE		3.1	11.4
TIMESHARING		0.5	1.3
USPS/EMSS		0.2	0.9
MAILBOX		0.3	0.9
ADMINISTRATIVE MESSAGES		15.9	53.7
FACSIMILE		1.7	2.7
COMMUNICATING WORD PROCESSORS		0.2	0.9
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		4.0	7.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		73.2	184.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		18.8	39.3
		18.8	39.3

TABLE I-39

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
INSTITUTION

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.0
PRIVATE LINE		0.2	1.9
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.3	2.8
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.2	0.7
DATA ENTRY		13.8	29.7
REMOTE JOB ENTRY		3.1	8.4
INQUIRY/RESPONSE		0.5	1.8
TIMESHARING		0.2	0.7
USPS/EMSS		0.1	0.5
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		7.9	26.8
FACSIMILE		0.3	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		26.6	69.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.1	6.6
		3.1	6.6

TABLE I-40

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
GOVERNMENT

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	2.2
PRIVATE LINE		0.4	4.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.7	6.9
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.2	0.4
DATA ENTRY		32.2	69.3
REMOTE JOB ENTRY		2.1	5.6
INQUIRY/RESPONSE		1.0	3.5
TIMESHARING		0.5	1.3
USPS/EMSS		0.0	0.2
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		15.9	53.7
FACSIMILE		0.8	1.3
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	0.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.2	2.3
		53.6	139.7
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		9.4	19.7
		9.4	19.7

TABLE I-41

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
PRIVATE

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.0
PRIVATE LINE		0.0	0.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA.SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.0	0.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.0
DATA ENTRY		4.6	9.9
REMOTE JOB ENTRY		0.0	0.0
INQUIRY/RESPONSE		0.2	0.9
TIMESHARING		0.0	0.0
USPS/EMSS		0.0	0.0
MAILBOX		0.0	0.0
ADMINISTRATIVE MESSAGES		0.0	0.0
FACSIMILE		0.0	0.0
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.0	0.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		4.8	10.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		0.0	0.0
		0.0	0.0

TABLE I-42

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
BUSINESS

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.9	9.8
PRIVATE LINE		5.9	37.1
MOBILE		0.0	0.2
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		7.8	47.2
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.4	1.1
DATA ENTRY		41.4	89.1
REMOTE JOB ENTRY		5.2	13.9
INQUIRY/RESPONSE		3.1	11.4
TIMESHARING		0.5	1.3
USPS/EMSS		0.2	0.9
MAILBOX		0.3	0.9
ADMINISTRATIVE MESSAGES		15.9	53.7
FACSIMILE		1.7	2.7
COMMUNICATING WORD PROCESSORS		0.2	0.9
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		4.0	7.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		73.2	184.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		18.8	39.3
		18.8	39.3

TABLE I-43

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
INSTITUTION

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.6	3.0
PRIVATE LINE		0.9	5.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.5	8.7
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.2	0.7
DATA ENTRY		13.8	29.7
REMOTE JOB ENTRY		3.1	8.4
INQUIRY/RESPONSE		0.5	1.8
TIMESHARING		0.2	0.7
USPS/EMSS		0.1	0.5
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		7.9	26.8
FACSIMILE		0.3	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		26.6	69.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.1	6.6
		3.1	6.6

TABLE I-44

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
GOVERNMENT

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		1.3	6.9
PRIVATE LINE		2.3	14.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		3.6	21.2
DATA TRANSFER		0.1	0.5
BATCH PROCESSING		0.2	0.4
DATA ENTRY		32.2	69.3
REMOTE JOB ENTRY		2.1	5.6
INQUIRY/RESPONSE		1.0	3.5
TIMESHARING		0.5	1.3
USPS/EMSS		0.0	0.2
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		15.9	53.7
FACSIMILE		0.8	1.3
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	0.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.2	2.3
		53.6	139.7
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		9.4	19.7
		9.4	19.7

TABLE I-45

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
PRIVATE

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.0
PRIVATE LINE		0.0	0.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA..SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.0	0.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.0
DATA ENTRY		4.6	9.9
REMOTE JOB ENTRY		0.0	0.0
INQUIRY/RESPONSE		0.2	0.9
TIMESHARING		0.0	0.0
USPS/EMSS		0.0	0.0
MAILBOX		0.0	0.0
ADMINISTRATIVE MESSAGES		0.0	0.0
FACSIMILE		0.0	0.0
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.0	0.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.0
		4.8	10.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		0.0	0.0
		0.0	0.0

TABLE I-46

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 1

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.7
PRIVATE LINE		0.2	1.9
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	2.6
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		10.0	21.5
REMOTE JOB ENTRY		1.1	3.0
INQUIRY/RESPONSE		0.5	1.9
TIMESHARING		0.1	0.4
USPS/EMSS		0.0	0.2
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		4.1	13.9
FACSIMILE		0.3	0.5
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	1.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		16.9	43.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.3	7.0
		3.3	7.0

TABLE I-47

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 2

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.5
PRIVATE LINE		0.4	4.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	5.8
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.5
DATA ENTRY		21.9	47.3
REMOTE JOB ENTRY		2.5	6.7
INQUIRY/RESPONSE		1.1	4.2
TIMESHARING		0.3	0.8
USPS/EMSS		0.1	0.4
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		9.0	30.5
FACSIMILE		0.6	1.0
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.1	2.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.5
		37.3	95.0
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.9	14.5
		6.9	14.5

TABLE I-48

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 3

ORIGINAL PAGE IS OF POOR QUALITY

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.5
PRIVATE LINE		0.4	4.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	5.7
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.5
DATA ENTRY		21.0	45.2
REMOTE JOB ENTRY		2.4	6.4
INQUIRY/RESPONSE		1.1	4.0
TIMESHARING		0.3	0.8
USPS/EMSS		0.1	0.4
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		9.2	31.2
FACSIMILE		0.7	1.0
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.1	2.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.7
		36.4	93.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		7.4	15.4
		7.4	15.4

TABLE I-49

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 4

ORIGINAL PAGE IS
OF POOR QUALITY

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.5
PRIVATE LINE		0.1	1.4
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	1.9
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		7.0	15.1
REMOTE JOB ENTRY		0.8	2.1
INQUIRY/RESPONSE		0.4	1.3
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.1	10.6
FACSIMILE		0.2	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		12.2	31.3
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.4	5.0
		2.4	5.0

TABLE I-50

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 5

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.2
PRIVATE LINE		0.3	3.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.4	4.5
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		16.1	34.7
REMOTE JOB ENTRY		1.8	4.9
INQUIRY/RESPONSE		0.8	3.1
TIMESHARING		0.2	0.6
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		7.0	23.7
FACSIMILE		0.5	0.8
COMMUNICATING WORD PROCESSORS		0.1	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.8	1.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.6
		27.7	71.3
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.7	12.0
		5.7	12.0

TABLE I-51

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 6

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.4
PRIVATE LINE		0.1	1.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	1.6
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.1
DATA ENTRY		6.2	13.3
REMOTE JOB ENTRY		0.7	1.9
INQUIRY/RESPONSE		0.3	1.2
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.6	8.9
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.6
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		10.6	27.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.1	4.4
		2.1	4.4

TABLE I-52

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 7

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.6
PRIVATE LINE		0.2	1.8
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	2.4
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		8.7	18.7
REMOTE JOB ENTRY		1.0	2.6
INQUIRY/RESPONSE		0.5	1.7
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.9	13.2
FACSIMILE		0.3	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		15.1	38.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.0	6.3
		3.0	6.3

TABLE I-53

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 8

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.3
PRIVATE LINE		0.1	0.8
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.1
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.6	7.8
REMOTE JOB ENTRY		0.4	1.1
INQUIRY/RESPONSE		0.2	0.7
TIMESHARING		0.0	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		1.7	5.7
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.3
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		6.4	16.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.3	2.7
		1.3	2.7

C-7

TABLE I-54

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS
REGION 9

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.6
PRIVATE LINE		0.1	1.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	2.2
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		7.6	16.3
REMOTE JOB ENTRY		0.9	2.3
INQUIRY/RESPONSE		0.4	1.5
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.3	11.3
FACSIMILE		0.2	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		13.1	33.7
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.7	5.7
		2.7	5.7

TABLE I-55

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 1

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.4	2.0
PRIVATE LINE		0.9	5.9
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.3	8.0
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		10.0	21.5
REMOTE JOB ENTRY		1.1	3.0
INQUIRY/RESPONSE		0.5	1.9
TIMESHARING		0.1	0.4
USPS/EMSS		0.0	0.2
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		4.1	13.9
FACSIMILE		0.3	0.5
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	1.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		16.9	43.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.3	7.0
		3.3	7.0

TABLE I-56

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 2

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.8	4.5
PRIVATE LINE		2.1	13.2
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		3.0	17.7
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.5
DATA ENTRY		21.9	47.3
REMOTE JOB ENTRY		2.5	6.7
INQUIRY/RESPONSE		1.1	4.2
TIMESHARING		0.3	0.8
USPS/EMSS		0.1	0.4
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		9.0	30.5
FACSIMILE		0.6	1.0
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.1	2.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.5
		37.3	95.0
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.9	14.5
		6.9	14.5

TABLE I-57

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 3

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.8	4.5
PRIVATE LINE		2.1	13.0
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.9	17.6
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.5
DATA ENTRY		21.0	45.2
REMOTE JOB ENTRY		2.4	6.4
INQUIRY/RESPONSE		1.1	4.0
TIMESHARING		0.3	0.8
USPS/EMSS		0.1	0.4
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		9.2	31.2
FACSIMILE		0.7	1.0
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.1	2.2
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.7
		36.4	93.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		7.4	15.4
		7.4	15.4

TABLE I-58

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 4

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	1.5
PRIVATE LINE		0.7	4.3
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.0	5.7
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		7.0	15.1
REMOTE JOB ENTRY		0.5	2.1
INQUIRY/RESPONSE		0.4	1.3
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.1	10.6
FACSIMILE		0.2	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		12.2	31.3
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.4	5.0
		2.4	5.0

ORIGINAL PAGE IS OF POOR QUALITY

TABLE I-59

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 5

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.7	3.5
PRIVATE LINE		1.6	10.1
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.3	13.7
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.1	0.4
DATA ENTRY		16.1	34.7
REMOTE JOB ENTRY		1.8	4.9
INQUIRY/RESPONSE		0.8	3.1
TIMESHARING		0.2	0.6
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		7.0	23.7
FACSIMILE		0.5	0.8
COMMUNICATING WORD PROCESSORS		0.1	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.8	1.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.1	0.6
		27.7	71.3
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.7	12.0
		5.7	12.0

TABLE I-60

ORIGINAL PAGE IS
OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 6

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.3
PRIVATE LINE		0.6	3.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.8	5.0
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.1
DATA ENTRY		6.2	13.3
REMOTE JOB ENTRY		0.7	1.9
INQUIRY/RESPONSE		0.3	1.2
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.6	8.9
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.6
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		10.6	27.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.1	4.4
		2.1	4.4

TABLE I-61

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 7

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.4	1.9
PRIVATE LINE		0.9	5.4
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.2	7.4
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		8.7	18.7
REMOTE JOB ENTRY		1.0	2.6
INQUIRY/RESPONSE		0.5	1.7
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.9	13.2
FACSIMILE		0.3	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		15.1	38.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.0	6.3
		3.0	6.3

TABLE I-62

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 8

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	0.8
PRIVATE LINE		0.4	2.4
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	3.2
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.6	7.8
REMOTE JOB ENTRY		0.4	1.1
INQUIRY/RESPONSE		0.2	0.7
TIMESHARING		0.0	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		1.7	5.7
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.3
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		6.4	16.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.3	2.7
		1.3	2.7

TABLE I-63

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS
REGION 9

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	1.8
PRIVATE LINE		0.8	5.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.1	6.8
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		7.6	16.3
REMOTE JOB ENTRY		0.9	2.3
INQUIRY/RESPONSE		0.4	1.5
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.3	11.3
FACSIMILE		0.2	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		13.1	33.7
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.7	5.7
		2.7	5.7

TABLE I-64

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 1

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.6
PRIVATE LINE		0.2	1.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	2.3
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		9.0	19.3
REMOTE JOB ENTRY		1.0	2.7
INQUIRY/RESPONSE		0.5	1.7
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.2
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.7	12.5
FACSIMILE		0.3	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	0.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		15.2	38.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.0	6.3
		3.0	6.3

TABLE I-65

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 2

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.3
PRIVATE LINE		0.3	3.9
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	5.2
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.5
DATA ENTRY		19.8	42.5
REMOTE JOB ENTRY		2.2	6.0
INQUIRY/RESPONSE		1.0	3.8
TIMESHARING		0.3	0.7
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		8.1	27.5
FACSIMILE		0.6	0.9
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.0	2.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.5
		33.5	85.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.2	13.0
		6.2	13.0

TABLE I-66

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 3

ORIGINAL PAGE IS
OF POOR QUALITY

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.3
PRIVATE LINE		0.3	3.8
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	5.2
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.2	0.4
DATA ENTRY		18.9	40.7
REMOTE JOB ENTRY		2.1	5.7
INQUIRY/RESPONSE		1.0	3.6
TIMESHARING		0.3	0.7
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		8.3	28.0
FACSIMILE		0.6	0.9
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.0	2.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		32.7	83.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.6	13.8
		6.6	13.8

TABLE I-67

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 4

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.4
PRIVATE LINE		0.1	1.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	1.7
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.1
DATA ENTRY		6.3	13.6
REMOTE JOB ENTRY		0.7	1.9
INQUIRY/RESPONSE		0.3	1.2
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.8	9.6
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.6
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		11.0	28.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA. SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.1	4.5
		2.1	4.5

TABLE I-68

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 5

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	1.0
PRIVATE LINE		0.3	3.0
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.4	4.0
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.3
DATA ENTRY		14.5	31.2
REMOTE JOB ENTRY		1.6	4.4
INQUIRY/RESPONSE		0.8	2.8
TIMESHARING		0.2	0.5
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		6.3	21.4
FACSIMILE		0.4	0.7
COMMUNICATING WORD PROCESSORS		0.0	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.7	1.4
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		25.0	64.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.2	10.8
		5.2	10.8

TABLE I-69

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 6

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.4
PRIVATE LINE		0.1	1.1
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.5
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.0	0.1
DATA ENTRY		5.6	12.0
REMOTE JOB ENTRY		0.6	1.7
INQUIRY/RESPONSE		0.3	1.1
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.4	8.0
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		9.5	24.4
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.9	3.9
		1.9	3.9

TABLE I-70

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 7

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.6
PRIVATE LINE		0.1	1.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	2.2
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		7.8	16.9
REMOTE JOB ENTRY		0.9	2.4
INQUIRY/RESPONSE		0.4	1.5
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.5	11.9
FACSIMILE		0.2	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		13.6	35.0
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.7	5.6
		2.7	5.6

TABLE I-71

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 8

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.0	0.2
PRIVATE LINE		0.1	0.7
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.1	1.0
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.3	7.1
REMOTE JOB ENTRY		0.4	1.0
INQUIRY/RESPONSE		0.2	0.6
TIMESHARING		0.0	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		1.5	5.1
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.3
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		5.8	14.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.2	2.4
		1.2	2.4

ORIGINAL PAGE IS OF POOR QUALITY

TABLE I-72

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS
REGION 9

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.5
PRIVATE LINE		0.1	1.5
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.2	2.0
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		6.8	14.7
REMOTE JOB ENTRY		0.8	2.1
INQUIRY/RESPONSE		0.4	1.3
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.0	10.2
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		11.8	30.3
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.5	5.1
		2.5	5.1

TABLE I-73

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 1

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	1.8
PRIVATE LINE		0.9	5.4
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.2	7.2
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		9.0	19.3
REMOTE JOB ENTRY		1.0	2.7
INQUIRY/RESPONSE		0.5	1.7
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.2
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.7	12.5
FACSIMILE		0.3	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.5	0.9
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		15.2	38.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		3.0	6.3
		3.0	6.3

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE I-74

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 2

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.8	4.1
PRIVATE LINE		1.9	12.0
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.7	16.1
DATA TRANSFER		0.1	0.3
BATCH PROCESSING		0.2	0.5
DATA ENTRY		19.8	42.5
REMOTE JOB ENTRY		2.2	6.0
INQUIRY/RESPONSE		1.0	3.8
TIMESHARING		0.3	0.7
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		8.1	27.5
FACSIMILE		0.6	0.9
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.0	2.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.5
		33.5	85.5
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA.SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.2	13.0
		6.2	13.0

TABLE I-75

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 3

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.8	4.0
PRIVATE LINE		1.9	11.8
MOBILE		0.0	0.1
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.7	15.9
DATA TRANSFER		0.1	0.2
BATCH PROCESSING		0.2	0.4
DATA ENTRY		18.9	40.7
REMOTE JOB ENTRY		2.1	5.7
INQUIRY/RESPONSE		1.0	3.6
TIMESHARING		0.3	0.7
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.3
ADMINISTRATIVE MESSAGES		8.3	28.0
FACSIMILE		0.6	0.9
COMMUNICATING WORD PROCESSORS		0.1	0.3
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		1.0	2.0
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		32.7	83.9
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		6.6	13.8
		6.6	13.8

TABLE I-76

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 4

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	1.3
PRIVATE LINE		0.6	3.9
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.9	5.2
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.1
DATA ENTRY		6.3	13.6
REMOTE JOB ENTRY		0.7	1.9
INQUIRY/RESPONSE		0.3	1.2
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.8	9.6
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.6
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		11.0	28.2
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.1	4.5
		2.1	4.5

TABLE I-77

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KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 5

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.6	3.2
PRIVATE LINE		1.5	9.1
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		2.1	12.4
DATA TRANSFER		0.0	0.2
BATCH PROCESSING		0.1	0.3
DATA ENTRY		14.5	31.2
REMOTE JOB ENTRY		1.6	4.4
INQUIRY/RESPONSE		0.8	2.8
TIMESHARING		0.2	0.5
USPS/EMSS		0.1	0.3
MAILBOX		0.1	0.2
ADMINISTRATIVE MESSAGES		6.3	21.4
FACSIMILE		0.4	0.7
COMMUNICATING WORD PROCESSORS		0.0	0.2
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.7	1.4
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.6
		25.0	64.1
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		5.2	10.8
		5.2	10.8

TABLE I-78

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 6

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.2	1.2
PRIVATE LINE		0.5	3.4
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.8	4.6
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.0	0.1
DATA ENTRY		5.6	12.0
REMOTE JOB ENTRY		0.6	1.7
INQUIRY/RESPONSE		0.3	1.1
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		2.4	8.0
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.3	0.5
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		9.5	24.4
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.9	3.9
		1.9	3.9

TABLE I-79

ORIGINAL PAGE IS OF POOR QUALITY

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 7

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	1.7
PRIVATE LINE		0.8	4.9
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.1	6.7
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		7.8	16.9
REMOTE JOB ENTRY		0.9	2.4
INQUIRY/RESPONSE		0.4	1.5
TIMESHARING		0.1	0.3
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.5	11.9
FACSIMILE		0.2	0.4
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.8
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.3
		13.6	35.0
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.7	5.6
		2.7	5.6

TABLE I-80

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KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 8

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.1	0.8
PRIVATE LINE		0.3	2.2
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCASIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		0.5	2.9
DATA TRANSFER		0.0	0.0
BATCH PROCESSING		0.0	0.1
DATA ENTRY		3.3	7.1
REMOTE JOB ENTRY		0.4	1.0
INQUIRY/RESPONSE		0.2	0.6
TIMESHARING		0.0	0.1
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		1.5	5.1
FACSIMILE		0.1	0.2
COMMUNICATING WORD PROCESSORS		0.0	0.0
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.2	0.3
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.1
		5.8	14.8
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCASIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		1.2	2.4
		1.2	2.4

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TABLE I-81

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS
REGION 9

	1980	1990	2000
MTS (RESIDENTIAL)		0.0	0.0
MTS (BUSINESS)		0.3	1.6
PRIVATE LINE		0.7	4.6
MOBILE		0.0	0.0
PUBLIC RADIO		0.0	0.0
COMMERCIAL AND RELIGIOUS		0.0	0.0
OCCA SIONAL		0.0	0.0
CATV MUSIC		0.0	0.0
RECORDING		0.0	0.0
		1.0	6.2
DATA TRANSFER		0.0	0.1
BATCH PROCESSING		0.1	0.2
DATA ENTRY		6.8	14.7
REMOTE JOB ENTRY		0.8	2.1
INQUIRY/RESPONSE		0.4	1.3
TIMESHARING		0.1	0.2
USPS/EMSS		0.0	0.1
MAILBOX		0.0	0.1
ADMINISTRATIVE MESSAGES		3.0	10.2
FACSIMILE		0.2	0.3
COMMUNICATING WORD PROCESSORS		0.0	0.1
TWX/TELEX		0.0	0.0
MAILGRAM/TELEGRAM/MONEY ORDERS		0.0	0.0
POINT OF SALE		0.4	0.7
VIDEOTEXT/TELETEXT		0.0	0.0
TELEMONITORING SERVICE		0.0	0.0
SECURE VOICE		0.0	0.2
		11.8	30.3
NETWORK		0.0	0.0
CATV		0.0	0.0
OCCA SIONAL		0.0	0.0
RECORDING CHANNEL		0.0	0.0
TELECONFERENCING		2.5	5.1
		2.5	5.1

TABLE I-82

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
REGION 1					10.0	3.2	6.8	0.5	25.5	8.4	17.7	1.2
REGION 2					21.7	7.0	14.8	1.2	55.7	18.5	38.5	2.6
REGION 3					21.6	6.9	14.7	1.1	55.3	18.2	38.3	2.5
REGION 4					7.2	2.3	4.9	0.4	18.4	6.1	12.8	0.8
REGION 5					16.5	5.3	11.3	0.8	42.4	14.0	29.5	1.9
REGION 6					6.3	2.0	4.3	0.3	16.0	5.3	11.1	0.7
REGION 7					8.7	2.9	6.1	0.5	23.0	7.6	16.0	1.0
REGION 8					3.8	1.2	2.6	0.2	9.8	3.2	6.8	0.4
REGION 9					7.8	2.5	5.3	0.4	20.1	6.6	14.0	0.9

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TABLE I-83

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
REGION 1					10.6	3.3	7.1	0.5	28.8	9.0	19.1	1.2
REGION 2					23.2	7.3	15.5	1.2	63.0	19.8	41.8	2.6
REGION 3					23.0	7.2	15.3	1.1	62.5	19.6	41.6	2.5
REGION 4					7.6	2.4	5.1	0.4	20.8	6.5	13.9	0.8
REGION 5					17.6	5.5	11.8	0.8	48.0	15.0	32.0	1.9
REGION 6					6.7	2.1	4.5	0.3	18.1	5.7	12.1	0.7
REGION 7					9.5	3.0	6.4	0.5	26.0	8.2	17.4	1.0
REGION 8					4.1	1.3	2.7	0.2	11.1	3.5	7.4	0.4
REGION 9					8.4	2.6	5.6	0.4	23.0	7.1	15.2	0.9

TABLE I-84

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
REGION 1					9.0	2.9	6.1	0.5	23.0	7.6	15.2	1.1
REGION 2					19.6	6.3	13.3	1.0	50.1	16.6	34.7	2.3
REGION 3					19.4	6.2	13.2	1.0	47.8	16.4	34.5	2.2
REGION 4					6.4	2.1	4.4	0.3	16.6	5.5	11.5	0.7
REGION 5					14.9	4.8	10.1	0.8	33.2	12.6	26.5	1.7
REGION 6					5.6	1.8	3.8	0.3	14.4	4.8	10.0	0.7
REGION 7					8.0	2.6	5.5	0.4	20.7	6.9	14.4	0.9
REGION 8					3.4	1.1	2.3	0.2	8.8	2.9	6.1	0.4
REGION 9					7.1	2.3	4.8	0.4	18.1	6.0	12.6	0.8

TABLE I-85

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
REGION 1					9.6	3.0	6.4	0.5	26.0	8.1	17.2	1.1
REGION 2					20.9	6.6	13.9	1.0	56.8	17.8	37.6	2.3
REGION 3					20.7	6.5	13.8	1.0	56.4	17.6	37.5	2.2
REGION 4					6.9	2.2	4.6	0.3	18.7	5.9	12.5	0.7
REGION 5					15.9	5.0	10.6	0.8	43.3	13.5	28.8	1.7
REGION 6					6.0	1.9	4.0	0.3	16.3	5.1	10.9	0.7
REGION 7					8.6	2.7	5.7	0.4	23.4	7.4	15.7	0.9
REGION 8					3.7	1.1	2.4	0.2	10.0	3.1	6.7	0.4
REGION 9					7.6	2.3	5.0	0.4	20.7	6.4	13.7	0.8

TABLE I-86

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
1 - 40					5.8	1.9	3.9	0.3	14.8	4.9	10.2	0.7
41 - 150					15.2	4.9	10.3	0.8	38.8	12.8	26.9	1.8
151 - 500					32.5	10.4	22.2	1.7	83.3	27.6	57.9	3.8
501 - 1000					28.6	9.2	19.5	1.5	73.3	24.2	50.7	3.3
1001 - 2100					17.9	5.7	12.2	0.9	45.9	15.2	31.9	2.1
2101 -					3.9	1.2	2.6	0.2	10.0	3.3	6.7	0.4

TABLE I-87

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .999 SHARED/UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
1 - 40					6.2	1.9	4.1	0.3	16.8	5.3	11.1	0.7
41 - 150					16.2	5.1	10.8	0.8	43.9	13.8	29.2	1.8
151 - 500					34.7	10.9	23.2	1.7	94.2	29.6	62.7	3.8
501 - 1000					30.5	9.5	20.4	1.5	82.9	26.0	55.3	3.3
1001 - 2100					19.1	6.0	12.8	0.9	52.1	16.3	34.7	2.1
2101 -					4.2	1.3	2.8	0.2	11.3	3.5	7.5	0.4

TABLE I-88

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
1 - 40					5.2	1.7	3.5	0.3	13.3	4.4	9.2	0.6
41 - 150					13.6	4.4	9.3	0.7	34.9	11.5	24.2	1.6
151 - 500					29.3	9.4	19.9	1.5	75.0	24.8	52.1	3.4
501 - 1000					25.7	8.3	17.5	1.3	66.0	21.8	45.8	3.0
1001 - 2100					16.1	5.2	11.0	0.8	41.3	13.7	28.7	1.7
2101 -					3.5	1.1	2.4	0.2	9.0	3.0	6.2	0.4

TABLE I-89

KA BAND CPS SATELLITE TRAFFIC
AVAIL = .995 SHARED/UNSHARED EARTH STATIONS

	1980				1990				2000			
	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV	BUSS	INST	GOV	PRIV
1 - 40					5.5	1.7	3.7	0.3	15.1	4.7	10.0	0.6
41 - 150					14.6	4.5	9.7	0.7	37.6	12.4	26.3	1.6
151 - 500					31.2	9.8	20.9	1.5	84.9	26.6	56.5	3.4
501 - 1000					27.5	8.6	18.3	1.3	74.7	23.4	49.8	3.0
1001 - 2100					17.2	5.4	11.5	0.8	46.9	14.7	31.2	1.9
2101 -					3.7	1.2	2.5	0.2	10.2	3.2	6.8	0.4

APPENDIX J
NATIONWIDE TRAFFIC DISTRIBUTION MODEL

J.1 INTRODUCTION

The objective of this task is to postulate a nationwide CPS network. This network considered several sizes of earth stations arranged in different configurations (shared and unshared) and having different availabilities (.995 and .999). The output of this task was the net accessible Ka-band forecast and detailed reports showing the size and location of every earth station predicted by the nationwide model.

J.2 METHODOLOGY

To determine the net accessible forecast it was necessary to begin with the net addressable forecast. The net addressable forecast was for two types of earth station configurations and two availabilities. These forecasts were then segmented into various clusters depending on where the traffic originated and terminated. Models were then developed which would simulate the typical SMSA and hinterlands. User profiles were developed which allowed the traffic to be segmented among the various users. The amount of traffic captured by a specific user determined whether the user would be a candidate for a CPS earth station. This accessible traffic was the output for this task. Figure J-1 represents the flow diagram of how these various steps fitted together to go from the net addressable to the net accessible.

J.3 NET ADDRESSABLE FORECAST

The input into the nationwide network model is the Ka-band net addressable forecast (Appendix I). The following configurations and availabilities were used.

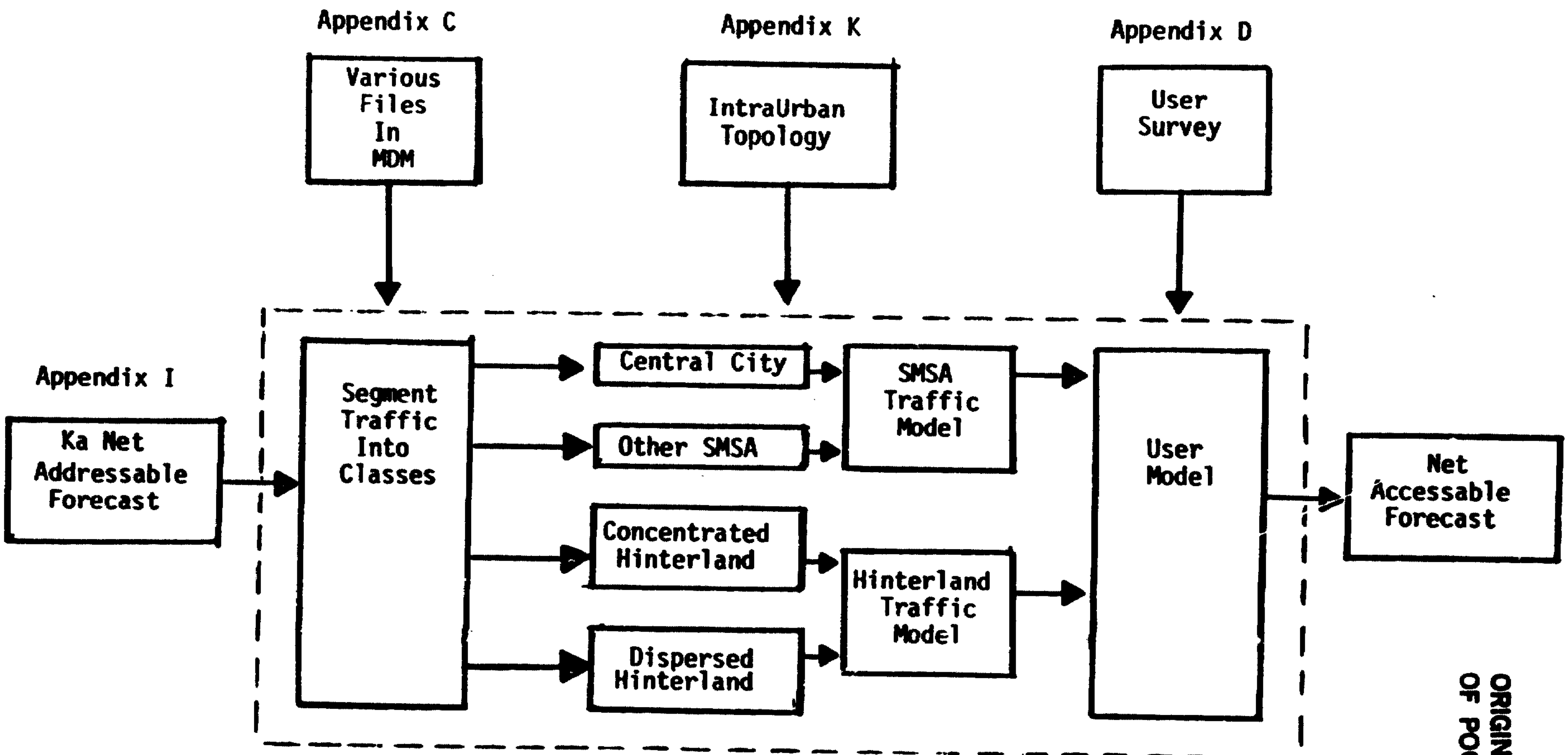

FIGURE J-1. NATIONWIDE TRAFFIC DISTRIBUTION MODEL

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Availability	Earth Station Configuration
.999	Unshared
.999	Shared/Unshared
.995	Unshared
.995	Shared/Unshared

These forecasts were distributed to all real and artificial SMSAs (Appendix J). This allowed the use of the nationwide CPS traffic model to analyze traffic on a specific SMSA or state hinterland bases.

J.4 SEGMENT TRAFFIC INTO CLASSES

In order to develop the nationwide network it was necessary to segment the traffic into various classes depending on where it originated or terminated. All traffic originates or terminates in one of the areas listed below. Figure J-2 depicts these four classes.

CLASSES OF TRAFFIC
Central city
Other SMSA
Concentrated Pockets in Hinterland
Dispersed Throughout Hinterland

J.4.1 Central City

This refers to a concept developed by the U.S. Department of Commerce. The central city is that area commonly referred to as the "downtown area." The Census Bureau, in defining the central city (or central business district) describes it as "an area of very high land valuation, characterized by a high concentration of retail businesses, offices, theatres, hotels, and "service" businesses, and an area of high automobile traffic." Information about the central city is compiled based on census tracts. Much of this information was analyzed using MDM and other computer models. In addition, in order to estimate the percent of SMSA traffic which is generated or terminated within the central city, three site visits

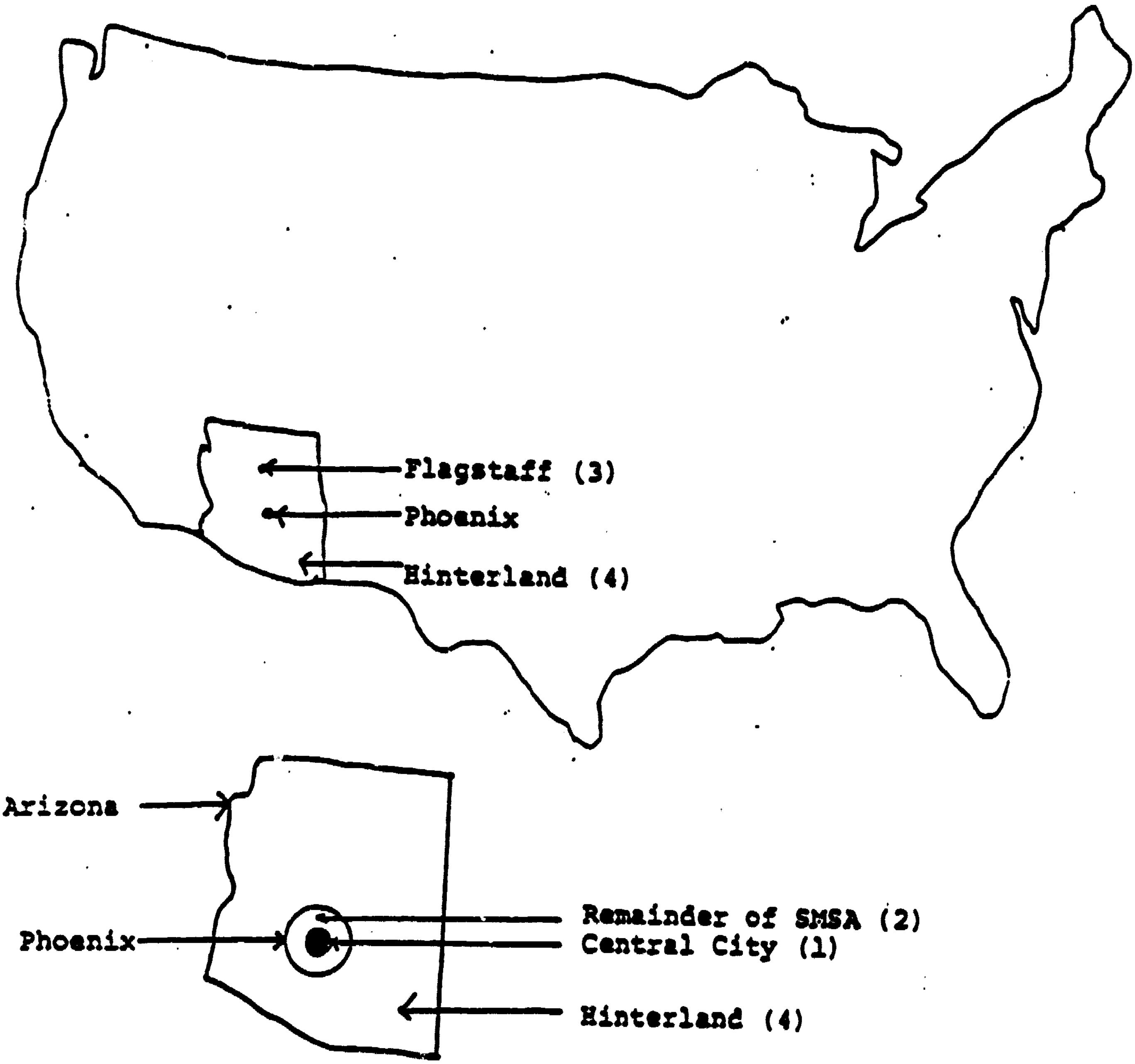

FIGURE J-2. TRAFFIC CLASSES

were made (see Appendix K). From this analysis it was concluded that 60% of the traffic going to or from an SMSA was central city traffic.

J.4.2 Other SMSA

The area of the SMSA located outside the central city was defined as "other SMSA" to distinguish it. The percent of SMSA traffic generated or terminated by this area is 40%. The following is the SMSA definition as given by the Bureau of the Census in the State and Area Metropolitan Area Data Book.

An SMSA usually includes a city (or cities) of a specified population size, which constitutes the central city and the county (or counties) in which it is located. (The exception is the Nassau-Suffolk, N.Y., SMSA which has no central city.) It also includes contiguous counties (A "contiguous" county either adjoins the county or counties containing the largest city in the area, or adjoins an intermediate county integrated with the central county. There is no limit to the number of tiers of outlying metropolitan counties so long as all other criteria are met.) when the economic and social relationships between the central and contiguous counties meet specified criteria of metropolitan character and integration. SMSA's may have up to three central and contiguous counties meet specified criteria of metropolitan character and integration. SMSA's may have up to three central cities and may cross State lines. In New England, SMSA's are composed of cities and towns instead of counties.

J.4.3 Population Criteria for SMSAs

Generally, SMSA's include a city or cities of specified population, determined either by city or cities of specified population, determined either by the 1970 Census of Population or by a subsequent special census or current estimates prepared by the Bureau of the Census.

1. With the one exception noted, each SMSA must include at least:
   a. One city with 50,000 or more inhabitants
   b. A city with at least 25,000 inhabitants, which, together with those contiguous places (incorporated or unincorporated) having population densities of at least 1,000

persons per square mile, has a combined population of 50,000 and constitutes a single community, provided that the county or counties in which the city and contiguous places are located has a total population of at least 75,000. (In New England, the cities and towns qualifying for inclusion in an SMSA must have a total population of at least 75,000.)

2. A contiguous county is included in an SMSA if:
   a. At least 75 percent of the resident labor force in the county is in the nonagricultural labor force, and
   b. At least 30 percent of the employed workers living in the county work in the central county or counties of the area.
3. A contiguous county which does not meet the requirements of criterion 2 is included in an SMSA if at least 75 percent of the resident labor force is in the non-agricultural labor force and it meets two of the following additional criteria of metropolitan character and one of the following criteria of integration:
   a. Criteria of metropolitan character:
      1. At least 25 percent of the population is urban
      2. The county had an increase of at least 15 percent in total population during the period covered by the two most recent censuses of population
      3. The county has a population density of at least 50 persons per square mile.
   b. Criteria of integration:
      1. At least 15 percent of the employed workers living in the county work in the central county or counties of the area, or
      2. The number of people working in the county who live in the central county or counties of the area is equal to at least 15 percent of the employed workers living in the county, or
      3. The sum of the number of workers commuting to and from the central county or counties is equal to 20 percent of the employed workers living in the county.

3.4.4 Concentrated Hinterland

The hinterland refers to all areas which fall outside the 313 designated SMSAs. Using information from Rand McNally and the Census Bureau the number of locations over 25,000 in population and outside the designated SMSAs were determined for each state. Population statistics revealed that 70 pecent of the rural population lived in such places. This was defined as the concentrated hinterland.

3.4.5 Dispersed Hinterland

Hinterland not located in cities over 25,000 was defined as dispersed hinterland. This includes a large portion of the west which is sparsely populated. Thirty percent of the population was found to live in such areas.

3.5 TRAFFIC MODELS

In order to provide the detail information required for a nationwide CPS network, it was necessary to develop SMSA and hinterland models. Traffic forecast had to be distributed to areas within a radius of 4 miles.

3.5.1 SMSA Traffic Models

A model which would approximate the typical SMSA was developed. This model allowed all SMSAs to be broken down into areas within a 4 mile radius, defined as a node. The center node was a circle with a 4 mile radius in the center of the SMSA. It was also assumed that the central city would be located in a circular area surrounding the center of the SMSA. The next group of nodes surrounded the initial node so that each in that "ring" is exactly the same distance from the center and includes the same area. The second ring contains eight nodes. Figure 3-3 shows the model applied to Phoenix. As seen by the first through fourth rings, the outside radius of each successive ring becomes smaller as one moves away from the center of the SMSA. (The fifth and sixth ring are not drawn to scale, to show the central city boundary.)

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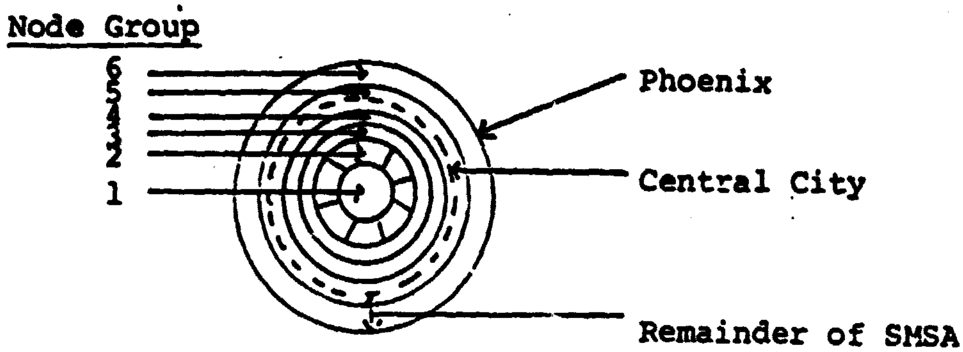

Figure J-3
SMSA Model

Since each node in a node ring is exactly alike it is necessary to calculate the traffic for only one node in each ring. Two assumptions about the dispersion of traffic are necessary to make these calculations. First, traffic is evenly dispersed across the central city. This assumption is based on the definition of central city, a built-up business area. The second assumption made was that traffic outside the central city declined as one moved out from the central city. Thus a node located directly outside the central city would have more traffic than a node located two rings away. Using these assumptions and the geometry of the SMSA model it was possible to develop the formula (Figure J-4) to calculate the traffic in a given SMSA node.

> (Percent of the node ring within the central city area x percent of the SMSA traffic located inside the central city x Traffic for the SMSA + percent of the node ring outside the central city area x percent of the SMSA traffic located outside the central city x traffic for the SMSA x Sensitivity Factor)/Number in node ring.

Figure J-4
Formula to Calculate SMSA Nodal Traffic

The formula is in two parts. The first part is concerned with traffic within the central city. These two parts are separated by a plus sign. The only ring where both parts are applicable is the one containing the boundary for the central city. The traffic calculated using these two parts is divided by the number in the node ring to find the amount of traffic in one node.

To find the portion of the traffic in the central city multiply the percent of the node ring within the central city area (this is 100 when the node ring is entirely inside the central city; 0 when the node ring is entirely outside the central city; somewhere in between when the node ring is bisected by the outer boundary of the central city) times the percent of traffic located inside the central city (60 percent) times the traffic for that SMSA (determine by the Market Distribution Model).

To find the portion of the traffic outside the central city multiply the percent of the node ring outside the central city (100 - the percent of the node ring inside the central city) times the percent of traffic located outside the node ring (40 percent) times the traffic for that SMSA (determined by the Market Distribution Model) times the sensitivity factor. The sensitivity factor calculated using the formulas below takes into account that traffic diminishes as one moves away from the central city.

Table J-1 below presents an example of how to calculate the sensitivity factor when the central city boundary falls within the third node ring.

Table J-1

Sensitivity Factor Example

	Factor	Normalized
3/3 =	1.000	.351
3/4 =	.750	.263
2/5 =	.600	.210
3/6 =	.500	.175
	2.850	1.000

J.5.2 Hinterland Traffic Model

Statistics show that small cities are very concentrated with most significant business located within a small radius of downtown. This area was treated as the central city, with a radius of 4 miles. As in the SMSA model, 60 percent of the traffic generated or terminated within the city was because of businesses located within this area. Traffic located outside the central city was too dispersed to justify an earth station. Likewise the "dispersed hinterland" class of traffic was too dispersed to justify an earth station and therefore was not involved in the model.

Another important concept of this model is the distribution factor. Census information reveals that cities over 25,000 vary widely in population and the number of businesses. It follows from this that a distribution of traffic must behave in a similar fashion. In order to approximate this, the distribution factor was included in the model. This factor adjusted the traffic for every state, distributing the traffic over the number of locations over 25,000 in population located within that state.

Using information from census along with the assumptions and concepts stated above the hinterland model was developed (Figure J-5) to calculate the traffic in a given hinterland city.

> Traffic for hinterland (that state) x percent of hinterland in these cities, percent of hinterland in these cities x percent of traffic concentrated downtown /Number of cities over 25,000 but not SMSAs x Distribution Factor.

Figure J-5

Formula to Calculate Hinterland City Traffic

The formula to calculate hinterland city traffic is applied to the 48 continental states. The hinterland traffic for each state is found through the concept of artificial SMSAs (Appendix C). This is multiplied by the percent of the hinterland population located in cities over 25,000 (70 percent). This, in turn, is multiplied by the percent of traffic concentrated in the central city (i.e., 60

percent). This is divided by the number of places over 25,000 but not SMSAs (based on Census and Rand McNally data). This yields the average amount of hinterland traffic per city throughout that particular state. The distribution factor is then applied to approximate traffic dispersion throughout the state. The formula for the dispersion factor is given in Figure J-6.

$(100 \pm 2 \times (A))$

$(98 \pm 2 \times (A - 2))$

$(96 \pm 2 \times (A - 4))$ When this term is equal to 1, the equation is set to 100.

Figure J-6
Formula for Dispersion Factor

The dispersion factor produces a percentage by which to increase or decrease the average hinterland city traffic. The formula must dipserse the traffic in both directions since there is a fixed amount of traffic. "A" in the formula refers to the number of cities within the state with a population of 25,000 or more. An example of how the dispersion factor is applied is shown below.

Traffic in hinterland equals 300 Mbps. There are 5 areas in the hinterland over 25,000 but outside the SMSAs. Traffic would be disbursed as follows:

$$\frac{300}{5} \times (.70 \times (.60) \times (100 \pm 2 \times (5) = \begin{matrix} 27.72 \\ 22.68 \end{matrix}$$

$$\frac{300}{5} \times (.70 \times (.60) \times (100 \pm 2 \times (5-2) = \begin{matrix} 27.72 \\ 22.68 \end{matrix}$$

$$\frac{300}{5} \times (.70 \times (.60) \times 1 = 25.20$$

J.6 USER MODELS

Since a CPS nationwide network by definition is user oriented, some assumptions about the amount of traffic which can be expected from specific users was necessary. Several sources of information were relied on to make these assumptions. Western Union's 100 years of providing servies to

specific users provided us with a good base of knowledge. In addition, a number of statistics were available on customer volumes of specific services. A computer analysis of the Dun and Bradstreet business file allowed us to study how organizations interact. From this file we could tell where headquarters, subsidiaries and branches were located; the dollar volume of the business at that location and the number of employees. Our intra-urban-topology research (Appendix K) provided a great deal of information about three specific SMSAs. Using these sources, we approximated what the percent of traffic which some particularly large users would have.

The nationwide CPS model required two sets of approximations since one network used only private earth stations (unshared network) while the other used a combination of private and shared stations (shared/unshared network).

Another aspect of the user model is the size of earth station which a particular customer would install. Our experience in this area and our site visits lead us to conclude that the minimum amount of traffic required to install a particular earth station was 50 percent of that earth station's burst rate.

J.6.1 Unshared Network Customers

The unshared network customer sizes allowed them to potentially capture up to 50 percent of the traffic which fell into a particular node. The remaining 50 percent of the traffic was scattered over users too small to effectively utilize a CPS earth station. Based on our analysis this was captured in the following fashion:

a. The largest customer within a node has traffic equal to 3/16 of that node.

b. The next largest customers within a node have traffic equal to 1/8 of that node. There can be 2 of these.

c. The next largest customers within a node have traffic equal to 1/16 of that node.

J.6.2 Shared/Unshared Network Customers

The shared/unshared network customer sizes allowed them to potentially capture up to 75 percent of the traffic which fell into a particular node. The remaining 25 percent of the traffic was scattered over users too small or too scattered tc effectively utilize a CPS earth station. Based on our analysis this was captured in the following fashion:

a. The largest customer within a node has traffic equal to 1/4 of that node.
b. The next largest customer within a node has traffic equal to 3/16 of that node.
c. The next largest customers within a node have traffic equal to 1/8 of that node. There can be 2 of these.
d. The next largest customer within a node has traffic equal to 1/16 of that node.
e. Traffic will go shared if the crossover favors this method.

J.7 EARTH STATION SIZE

The size of the earth station which a particular user or group of users would install depends on the amount of traffic they have and whether it is an unshared or shared earth station. Table J-2 below presents the types of earth station considered in this analysis. A full description of each of these earth stations can be found in the cost analysis appendix (Appendix F).

Table J-2
Earth Station Sizes

Unshared	Shared
6.2 MBPS	32.0 MBPS
1.5 MBPS	6.2 MBPS
64 KBPS	1.5 MBPS

J.8 NATIONWIDE CPS NETWORK REPORTS

The output of the nationwide CPS network model is a series of four reports (Tables J-4–J-7); two for the different availability levels and two for the different earth station configurations. Table J-. is a reference to these printouts.

Table J-3
Table Numbers of CPS Reports

Availability	Configuration	Table Numbers
.995	Unshared	J-7
.995	Shared/Unshared	J-5
.999	Unshared	J-6
.999	Shared/Unshared	J-4

Column 1 in each of these tables is the order in which the SMSA or the group of cities comprising the states hinterlands ranks when the amount of traffic which could be captured by a nationwide CPS network in the year 2000. Column 2 presents the SMSA or state (in addition, states include a " " to easily identify them). Column 3 is the amount of traffic one could expect to capture. The next four columns show the number of each type of earth station to expect in each location. Table J-2 identifies the various size earth station with the appropriate column headings. The last column gives the number of square miles in the central city. Some definitional problems existed with just what constitutes a central city. To avoid these problems, a limiting percentage was applied as it was the metropolitan area. The largest a central city could be was limited to 4 percent of the total metropolitan area of the particular SMSA.

The next three columns show the amount of traffic by service type which was either transmitted or terminated within a particular area. This allocation was based on the market distribution (Appendix C) and was similar to the CPS distribution as explained in Appendix H. The next column is a summary of the traffic allocated to a specific area. The captured column is the ratio of the traffic captured to the total amount of traffic allocated. The number of square

miles in the metropolitan area is given in the next column. The size of the SMSAs is limited to 3500 square miles. This assumption is based on the sphere of influence or the effective distance which an SMSA has major business located away from the central city. For states, this column is the number of locations in that state over 25,000 in population but not part of an SMSA.

TABLE J-4

.999 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
1 NEW YORK NY-NJ	692.60	2	139	297	4	833.83	66.25	460.18	1380.25	50.18	1384	237
2 CHICAGO IL	347.10	3	64	130	6	529.38	41.08	285.32	855.78	40.56	3500	140
3 LOS ANGELES-LONG BEA	259.25	2	50	93	4	347.53	26.97	187.30	561.80	46.15	3500	140
4 PHILADELPHIA PA-NJ	153.75	0	15	142	4	305.92	23.74	164.88	494.53	31.09	3500	140
5 DETROIT MI	144.75	0	15	130	3	279.77	21.71	150.78	452.26	32.01	3500	140
6 WASHINGTON DC-MD	138.60	0	14	126	4	262.70	20.38	141.58	424.66	32.64	2812	116
7 BOSTON MA	92.70	0	3	111	3	189.74	14.72	102.26	306.73	30.22	1233	200
8 BALTIMORE MD	87.15	0	6	91	2	176.00	13.72	95.29	285.01	30.49	2259	138
9 HOUSTON TX	86.55	0	7	86	3	179.74	13.95	96.87	290.57	29.79	3500	140
10 ATLANTA GA	85.65	0	6	89	2	160.47	12.45	86.48	259.40	33.02	3500	140
11 MINNEAPOLIS-ST PAUL	82.95	0	8	77	3	169.95	13.19	91.60	274.74	30.[illegible]	3500	140
12 DALLAS-FORT WORTH TX	82.05	0	7	80	3	155.87	12.09	84.01	251.97	32.56	3500	140
13 NASSAU-SUFFOLK NY	79.95	0	3	74	2	168.55	13.08	90.84	272.47	29.34	1218	202
14 ST LOUIS MO-IL	79.95	0	8	73	2	158.13	12.27	85.22	255.62	31.28	3500	140
15 CLEVELAND OH	76.35	0	9	64	2	169.48	13.15	91.34	273.98	27.87	1519	112
16 MILWAUKEE WI	70.20	0	3	81	2	134.79	10.46	72.65	217.90	32.22	1455	161
17 NEWARK NJ	69.15	0	1	88	2	130.13	10.10	70.14	210.37	32.87	1008	217
18 PITTSBURGH PA	67.65	0	6	65	2	178.28	13.83	96.08	288.19	23.47	3049	146
19 SAN FRANCISCO-OAKLAN	67.50	0	5	69	3	128.32	9.96	69.16	207.43	32.54	2480	143
20 DENVER-BOULDER CO	58.50	0	5	57	2	106.69	8.28	57.50	172.47	33.92	3500	140
21 CINCINNATI OH-KY	55.50	0	5	53	2	133.32	10.34	71.85	215.52	25.75	2149	136
22 JERSEY CITY NJ	53.25	0	15	8	0	56.78	4.41	30.60	91.79	58.01	47	21
23 MIAMI FL	50.25	0	5	46	1	92.09	7.15	49.63	148.86	33.76	2042	133
24 KANSAS CITY MO-KS	47.55	0	2	55	2	105.69	8.20	56.96	170.85	27.83	3341	143
25 * NEW YORK	42.75	0	0	57	0	173.14	13.43	93.31	279.88	15.27	6	
26 COLUMBUS OH	42.30	0	2	48	2	110.20	8.55	59.40	178.15	23.74	2459	142
27 NEW HAVEN-WEST HAVEN	42.15	0	1	52	1	74.58	5.79	40.19	120.56	34.96	337	125
28 INDIANAPOLIS IN	38.70	0	3	39	2	117.13	9.09	63.13	189.34	20.44	3072	145
29 MERIDEN CT	35.40	0	6	22	0	41.26	3.20	22.24	66.71	53.07	24	24
30 BUFFALO NY	33.60	0	4	28	2	99.84	7.75	53.81	161.39	20.82	1590	116
31 DAYTON OH	29.55	0	2	31	2	84.99	6.59	45.80	137.39	21.51	1707	121
32 NEW ORLEANS LA	29.55	0	2	31	1	85.92	6.67	46.31	138.90	21.27	1966	130
33 LOUISVILLE KY-IN	29.25	0	0	39	2	95.25	7.39	51.33	153.97	19.00	1392	174
34 BRIDGEPORT CT	29.25	0	0	39	1	62.80	4.87	33.85	101.52	28.81	198	120
35 AKRON OH	28.50	0	0	38	2	72.85	5.65	39.26	117.77	24.20	903	216
36 TAMPA-ST PETERSBURG	28.05	0	2	29	1	74.27	5.76	40.03	120.06	23.36	2045	133
37 BRISTOL CT	27.90	0	6	12	0	41.16	3.19	22.18	66.53	41.93	79	34
38 SAN DIEGO CA	27.30	0	2	28	1	78.91	6.12	42.53	127.56	21.40	3500	140
39 OKLAHOMA CITY OK	27.30	0	2	28	1	76.56	5.94	41.26	123.[illegible]	22.06	3491	140
40 MEMPHIS TN-AR	25.80	0	2	26	2	81.61	6.33	43.99	131.93	19.56	2298	137
41 PHOENIX AZ	25.80	0	2	26	1	72.68	5.64	39.17	117.50	21.96	3500	140
42 HARTFORD CT	25.50	0	0	34	2	87.23	6.77	47.01	141.01	18.08	1032	216
43 PROVIDENCE-WARWICK-P	25.50	0	0	34	2	77.78	6.04	41.92	125.74	20.28	747	206
44 SEATTLE-EVERETT WA	25.05	0	2	25	1	66.79	5.18	36.00	107.96	23.20	3500	140
45 BIRMINGHAM AL	24.90	0	1	29	2	76.62	5.95	41.29	123.86	20.10	3358	142
46 SPRINGFIELD-CHICOPEE	24.75	0	0	33	2	66.66	5.17	35.93	107.75	22.97	633	191
47 ROCHESTER NY	24.15	0	1	28	2	86.69	6.73	46.72	140.13	17.23	2966	146
48 TULSA OK	24.15	0	1	28	1	66.48	5.16	35.83	107.47	22.47	3500	140
49 TOLEDO OH-MI	23.25	0	0	31	2	76.64	5.95	41.30	123.89	18.77	2187	137
50 NEW BRUNSWICK-PERTH	23.25	0	0	31	1	61.31	4.76	33.05	99.12	23.46	312	118
51 CHARLOTTE-GASTONIA N	22.80	0	2	22	2	75.06	5.82	40.45	121.34	18.79	1525	113
52 SAN ANTONIO TX	22.65	0	1	26	1	61.07	4.74	32.92	98.75	22.94	2527	143
53 NORWALK CT	22.20	0	3	17	0	34.30	2.66	18.49	55.45	40.04	88	38
54 PORTLAND OR-WA	21.90	0	1	25	1	56.80	4.41	30.61	91.82	23.85	3500	140
55 SALT LAKE CITY-OGDEN	21.90	0	1	25	1	52.14	4.05	28.10	84.28	25.98	3500	140

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TABLE.

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	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
56 NEW BRITAIN CT	21.60	0	4	12	0	43.56	3.38	23.48	70.42	30.67	119	50
57 NASHVILLE-DAVIDSON T	21.15	0	1	24	2	84.13	6.53	45.34	136.00	15.55	3500	140
58 NORTHEAST PENNSYLVAN	19.65	0	1	22	2	80.39	6.24	43.33	129.96	15.12	1951	130
59 HARRISBURG PA	19.65	0	1	22	2	72.32	5.61	38.98	116.90	16.81	1624	117
60 STAMFORD CT	19.20	0	3	13	0	40.44	3.14	21.80	65.38	29.37	121	51
61 OMAHA NE-IA	19.05	0	2	17	1	60.79	4.72	32.76	98.27	19.39	1537	113
62 LONG BRANCH-ASBURY P	18.75	0	0	25	1	55.58	4.31	29.76	89.85	20.87	476	161
63 BURLINGTON NC	18.75	0	0	25	1	51.53	4.00	27.77	83.31	22.51	428	150
64 RICHMOND VA	18.15	0	1	20	2	80.50	6.25	43.39	130.13	13.95	2145	136
65 ALBANY-SCHENECTADY-T	18.00	0	0	24	2	81.00	6.29	43.66	130.94	13.75	2624	144
66 * PENNSYLVANIA	18.00	0	0	24	0	96.40	7.48	51.96	155.83	11.55	7	
67 ANAHEIM-SANTA ANA-GA	17.25	0	0	23	1	57.28	4.44	30.87	92.60	18.63	782	209
68 SAN JOSE CA	17.25	0	0	23	1	57.12	4.43	30.79	92.34	18.68	1300	171
69 FORT LAUDERDALE-HOLL	17.25	0	0	23	1	50.15	3.89	27.03	81.06	21.28	1219	202
70 DES MOINES IA	16.50	0	0	22	1	54.51	4.23	29.38	88.12	18.73	1136	210
71 WATERBURY CT	16.50	0	0	22	0	49.24	3.82	26.54	79.60	20.73	257	100
72 PATERSON-CLIFTON-PAS	16.05	0	2	13	0	48.21	3.74	25.98	77.93	20.60	192	78
73 JACKSONVILLE FL	15.90	0	1	17	1	61.56	4.78	33.18	99.51	15.98	3199	144
74 BATON ROUGE LA	15.90	0	1	17	1	48.43	3.76	26.10	78.28	20.31	1617	117
75 JACKSON MS	15.90	0	1	17	1	46.38	3.60	25.00	74.98	21.21	1651	118
76 ALLENTOWN-BETHLEHEM-	15.75	0	0	21	2	71.83	5.57	38.71	116.12	13.56	1470	152
77 SACRAMENTO CA	15.75	0	0	21	1	53.30	4.14	28.73	86.16	18.28	3434	141
78 NEWPORT NEWS-HAMPTON	15.75	0	0	21	1	52.38	4.06	28.23	84.67	18.60	638	192
79 AUSTIN TX	15.75	0	0	21	1	50.80	3.94	27.38	82.12	19.18	2766	145
80 WICHITA KS	15.75	0	0	21	1	49.54	3.84	26.70	80.09	19.67	2448	142
81 RALEIGH-DURHAM NC	15.15	0	1	16	1	61.66	4.78	33.23	99.68	15.20	1553	114
82 ORLANDO FL	15.15	0	1	16	1	49.20	3.82	26.56	79.67	19.02	2528	143
83 WEST PALM BEACH-BOCA	15.15	0	1	16	1	39.69	3.08	21.39	64.16	23.61	2023	132
84 NASHUA NH	15.15	0	1	16	0	36.82	2.86	19.85	59.53	25.45	154	64
85 BROCKTON MA	15.15	0	1	16	0	35.77	2.78	19.28	57.82	26.20	137	57
86 * NEW JERSEY	15.00	0	0	20	0	57.81	4.49	31.16	93.46	16.05	3	
87 LOWELL MA-NH	15.00	0	0	20	0	40.09	3.11	21.61	64.81	23.15	179	73
88 NORFOLK-VIRGINIA BEA	14.25	0	0	19	2	74.09	5.75	39.93	119.77	11.90	1337	341
89 GRAND RAPIDS MI	14.25	0	0	19	2	69.79	5.42	37.62	112.83	12.63	1420	169
90 LANSING-EAST LANSING	14.25	0	0	19	2	67.88	5.27	36.58	109.73	12.99	2277	139
91 COLUMBIA SC	13.50	0	0	18		56.84	4.41	30.63	91.88	14.67	1465	158
92 LAWRENCE-HAVERHILL M	13.50	0	[illegible]	18	0	42.12	3.27	22.70	68.08	19.83	305	116
93 FLINT MI	12.00	0	0	16	2	55.05	4.27	29.67	88.99	13.48	1182	206
94 LITTLE ROCK-NORTH LI	12.00	0	0	16	1	51.17	3.97	27.58	82.72	14.51	1489	153
95 WORCESTER MA	12.00	0	0	16	1	49.76	3.86	26.82	80.44	14.92	558	178
96 CHARLESTON-NORTH CHA	12.00	0	0	16	1	47.35	3.67	25.52	76.54	15.68	2618	144
97 * VIRGINIA	12.00	0	0	16	0	62.11	4.82	33.47	100.40	11.95	5	
98 ELKHART IN	12.00	0	0	16	0	43.02	3.34	23.19	69.55	17.25	468	159
99 RACINE WI	12.00	0	0	16	0	37.29	2.89	20.10	60.27	19.91	337	125
100 GREENSBORO-WINSTON-S	11.25	0	0	15	2	71.45	5.54	38.51	115.50	9.74	3213	144
101 SYRACUSE NY	11.25	0	0	15	2	67.99	5.28	36.65	107.92	10.24	2419	142
102 FORT WAYNE IN	11.25	0	0	15	2	62.12	4.82	33.48	100.42	11.20	1750	122
103 KNOXVILLE TN	11.25	0	0	15	1	58.86	4.57	31.72	95.15	11.82	1630	117
104 TRENTON NJ	11.25	0	0	15	1	47.88	3.71	25.80	77.39	14.54	228	90
105 NEW BEDFORD MA	11.25	0	0	15	1	41.08	3.19	22.14	66.41	16.94	206	83
106 ALBUQUERQUE NM	11.25	0	0	15	1	38.84	3.01	20.93	62.78	17.92	3500	140
107 LAFAYETTE LA	11.25	0	0	15	1	31.30	2.43	16.87	50.60	22.24	263	109
108 FITCHBURG-LEOMINSTER	11.25	0	0	15	0	34.71	2.69	18.71	56.11	20.05	167	69
109 WILMINGTON DE-NJ	10.50	0	0	14	2	68.14	5.29	36.72	110.15	9.53	1165	208
110 YORK PA	10.50	0	0	14	2	56.98	4.42	30.71	92.11	11.40	1435	165

TABLE J-4

.779 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
111 YOUNGSTOWN-WARREN OH	10.50	0	0	14	2	56.82	4.41	30.63	91.06	11.43	1023	216
112 READING PA	10.50	0	0	14	2	56.23	4.37	30.33	90.97	11.54	862	215
113 MADISON WI	10.50	0	0	14	2	55.89	4.34	30.12	90.35	11.62	1198	204
114 GARY-HAMMOND-EAST CH	10.50	0	0	14	2	55.84	4.33	30.10	90.27	11.63	937	217
115 POUGHKEEPSIE NY	10.50	0	0	14	2	55.01	4.27	29.65	88.93	11.81	813	212
116 CHARLESTON WV	10.50	0	0	14	2	53.50	4.15	28.84	86.49	12.14	1255	197
117 NEW LONDON-NORWICH C	10.50	0	0	14	1	47.32	3.67	25.50	76.50	13.73	478	162
118 LORAIN-ELYRIA OH	10.50	0	0	14	0	45.69	3.55	24.63	73.86	14.22	495	166
119 VINELAND-MILLVILLE-B	10.50	0	0	14	0	43.60	3.38	23.50	70.49	14.90	500	167
120 ELMIRA NY	10.50	0	0	14	0	42.49	3.30	22.90	68.69	15.29	415	147
121 PITTSFIELD MA	10.50	0	0	14	0	41.66	3.23	22.46	67.35	15.59	213	85
122 GREEN BAY WI	10.50	0	0	14	0	38.76	3.01	20.89	62.65	16.76	524	172
123 BAY CITY MI	10.50	0	0	14	0	38.24	2.97	20.61	61.82	16.99	447	155
124 CANTON OH	9.75	0	0	13	2	54.69	4.24	29.48	88.41	11.03	965	217
125 LANCASTER PA	9.75	0	0	13	2	53.70	4.17	28.94	86.81	11.23	946	217
126 SOUTH BEND IN	9.75	0	0	13	2	53.68	4.17	28.93	86.77	11.24	909	216
127 ERIE PA	9.75	0	0	13	2	52.36	4.06	28.22	84.65	11.52	813	212
128 ANN ARBOR MI	9.75	0	0	13	2	51.24	3.98	27.62	82.84	11.77	71[illegible]	202
129 ATLANTIC CITY NJ	9.75	0	0	13	1	47.16	3.66	25.42	76.24	12.79	569	181
130 HAMILTON-MIDDLETOWN	9.75	0	0	13	1	45.11	3.50	24.31	72.92	13.37	471	160
131 COLUMBUS GA-AL	9.75	0	0	13	1	40.34	[illegible].13	21.74	65.22	14.95	1100	213
132 LINCOLN NE	9.75	0	0	13	1	39.13	3.04	21.09	63.26	15.41	845	214
133 EL PASO TX	9.75	0	0	13	1	34.51	2.68	18.60	55.78	17.48	1057	215
134 SARASOTA FL	9.75	0	0	13	1	30.08	2.33	16.21	48.63	20.05	587	184
135 ALTOONA PA	9.75	0	0	13	0	43.79	3.40	23.60	70.80	13.77	530	173
136 LAFAYETTE-WEST LAFAY	9.75	0	0	13	0	43.61	3.38	23.50	70.49	13.83	500	167
137 MANSFIELD OH	9.75	0	0	13	0	43.38	3.37	23.38	70.13	13.90	496	166
138 ANDERSON IN	9.75	0	0	13	0	41.28	3.20	22.25	66.73	1[illegible].61	453	156
139 HAGERSTOWN MD	9.75	0	0	13	0	40.30	3.13	21.72	65.14	14.97	459	157
140 LA CROSSE WI	9.75	0	0	13	0	32.50	2.52	17.52	52.54	18.56	451	155
141 LAWRENCE KS	9.75	0	0	13	0	28.89	2.24	15.57	46.70	20.88	471	160
142 GALVESTON-TEXAS CITY	9.75	0	0	13	0	27.88	2.16	15.03	45.07	21.63	399	142
143 STEUBENVILLE-WEIRTON	9.00	0	0	12	0	44.10	3.42	23.77	71.30	12.62	582	183
144 NEWARK OH	9.00	0	0	12	0	42.15	3.27	22.72	68.14	13.21	686	199
145 ROCKFORD IL	8.25	0	0	11	2	50.36	3.91	27.14	81.41	10.13	802	211
146 GREENVILLE-SPARTANBU	8.25	0	0	11	1	56.08	4.35	30.23	70.66	9.10	2115	135
147 CHATTANOOGA TN-GA	8.25	0	0	11	1	54.89	4.26	29.58	88.73	9.30	2109	135
148 PEORIA IL	8.25	0	0	11	1	54.06	4.19	29.14	87.39	9.44	1803	125
149 DAVENPORT-ROCK ISLAN	8.25	0	0	11	1	49.31	3.83	26.57	79.70	10.35	1704	121
150 SAGINAW MI	8.25	0	0	11	1	45.48	3.53	24.51	73.51	11.22	814	212
151 FAYETTEVILLE NC	8.25	0	0	11	1	43.67	3.39	23.54	70.59	11.69	654	174
152 MANCHESTER NH	8.25	0	0	11	1	41.79	3.24	22.52	67.55	12.21	258	101
153 BENTON HARBOR MI	8.25	0	0	11	1	39.53	3.07	21.30	63.90	12.91	580	183
154 * KENTUCKY	8.25	0	0	11	0	52.56	4.08	28.33	84.97	9.71	4	
155 * MINNESOTA	8.25	0	0	11	0	49.46	3.84	26.66	79.96	10.32	7	
156 * NEBRASKA	8.25	0	0	11	0	30.04	2.33	16.19	48.56	16.99	2	
157 JOHNSON CITY-KINGSPO	7.50	0	0	10	2	54.37	4.22	29.30	87.89	8.53	2866	146
158 JOHNSTOWN PA	7.50	0	0	10	1	49.91	3.87	26.90	80.69	9.29	1770	123
159 EVANSVILLE IN-KY	7.50	0	0	10	1	48.11	3.73	25.93	77.77	9.64	1975	131
160 HUNTSVILLE AL	7.50	0	0	10	1	46.51	3.61	25.07	75.18	9.98	1919	129
161 AUGUSTA GA-SC	7.50	0	0	10	1	45.89	3.56	24.73	74.18	10.11	1700	120
162 CEDAR RAPIDS IA	7.50	0	0	10	1	40.36	3.13	21.75	65.24	11.50	717	203
163 WATERLOO-CEDAR FALLS	7.50	0	0	10	1	34.99	2.72	18.86	56.57	13.26	568	180
164 ROCHESTER MN	7.50	0	0	10	1	34.16	2.65	18.41	55.22	13.58	656	195
165 ANNISTON AL	7.50	0	0	10	1	33.85	2.63	18.24	54.72	13.71	611	188

.999 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
166 DAYTONA BEACH FL	7.50	0	0	10	1	33.00	2.56	17.79	53.35	14.06	1062	215
167 GADSDEN AL	7.50	0	0	10	1	32.63	2.53	17.59	52.75	14.22	555	178
168 MONROE LA	7.50	0	0	10	1	32.56	2.53	17.55	52.64	14.25	638	192
169 MELBOURNE-TITUSVILLE	7.50	0	0	10	1	32.50	2.52	17.52	52.54	14.27	1011	216
170 LUBBOCK TX	7.50	0	0	10	1	32.34	2.51	17.43	52.27	14.35	893	216
171 ALBANY GA	7.50	0	0	10	1	32.05	2.49	17.27	51.81	14.48	678	198
172 SIOUX FALLS SD	7.50	0	0	10	1	30.04	2.33	16.19	48.56	15.44	813	212
173 FORT MYERS FL	7.50	0	0	10	1	29.05	2.25	15.66	46.96	15.97	785	209
174 * MARYLAND	7.50	0	0	10	0	54.51	4.23	29.38	88.13	8.51	5	
175 * OKLAHOMA	7.50	0	0	10	0	28.19	2.19	15.20	45.58	16.46	3	
176 * SOUTH DAKOTA	7.50	0	0	10	0	22.81	1.77	12.30	36.88	20.34	2	
177 * NORTH DAKOTA	7.50	0	0	10	0	22.11	1.72	11.92	35.75	20.98	2	
178 LIMA OH	6.75	0	0	9	2	48.50	3.76	26.14	78.40	8.61	1705	121
179 BINGHAMTON NY-PA	6.75	0	0	9	1	51.18	3.97	27.58	82.74	8.16	2071	134
180 HUNTINGTON-ASHLAND W	6.75	0	0	9	1	48.09	3.73	25.92	77.73	8.68	1756	123
181 KENOSHA WI	6.75	0	0	9	1	34.08	2.64	18.37	55.09	12.25	272	105
182 * TENNESSEE	6.75	0	0	9	0	51.11	3.97	27.54	82.62	8.17	4	
183 GLENS FALLS NY	6.75	0	0	9	0	38.98	3.02	21.01	63.02	10.71	1723	121
184 DANBURY CT	6.75	0	0	9	0	35.04	2.72	18.89	56.64	11.92	255	109
185 MUNCIE IN	6.00	0	0	8	2	42.44	3.29	22.87	68.60	8.75	396	142
186 TERRE HAUTE IN	6.00	0	0	8	1	43.39	3.37	23.38	70.14	8.55	1499	150
187 SHREVEPORT LA	6.00	0	0	8	1	43.26	3.36	23.32	69.93	8.58	2363	141
188 MONTGOMERY AL	6.00	0	0	8	1	42.06	3.26	22.67	68.00	8.82	2013	132
189 BLOOMINGTON IN	6.00	0	0	8	1	39.80	3.09	21.45	64.34	9.33	386	139
190 PORTLAND ME	6.00	0	0	8	1	37.78	2.93	20.36	61.07	9.82	367	134
191 TOPEKA KS	6.00	0	0	8	1	37.48	2.91	20.20	60.59	9.90	1764	123
192 * MISSOURI	6.00	0	0	8	0	60.36	4.68	32.53	97.58	6.15	7	
193 * CALIFORNIA	6.00	0	0	8	0	41.72	3.24	22.49	67.45	8.90	5	
194 * TEXAS	6.00	0	0	8	0	40.22	3.12	21.68	65.02	9.23	4	
195 * MISSISSIPPI	6.00	0	0	8	0	35.32	2.74	19.03	57.09	10.51	5	
196 SHEBOYGAN WI	6.00	0	0	8	0	35.23	2.73	18.99	56.95	10.54	1776	124
197 * FLORIDA	6.00	0	0	8	0	33.74	2.62	18.18	54.54	11.00	5	
198 * KANSAS	6.00	0	0	8	0	32.70	2.54	17.62	52.86	11.35	5	
199 LEWISTON-AUBURN ME	6.00	0	0	8	0	30.32	2.35	16.34	49.02	12.24	102	96
200 RIVERSIDE-SAN BERNAR	5.25	0	0	7	1	43.40	3.37	23.39	70.16	7.48	3500	140
201 MOBILE AL	5.25	0	0	7	1	43.01	3.34	23.18	69.52	7.55	2818	146
202 LAS VEGAS NV	5.25	0	0	7	1	40.82	3.17	22.00	65.99	7.96	3500	140
203 DULUTH-SUPERIOR MN-W	5.25	0	0	7	1	40.11	3.11	21.62	64.84	8.10	3500	140
204 BEAUMONT-PORT ARTHUR	5.25	0	0	7	1	36.93	2.87	19.90	59.70	8.79	2207	137
205 PENSACOLA FL	5.25	0	0	7	1	36.56	2.84	19.71	59.11	8.88	1697	120
206 FRESNO CA	5.25	0	0	7	1	36.17	2.81	19.49	58.47	8.98	3500	140
207 TUCSON AZ	5.25	0	0	7	1	36.03	2.80	19.42	58.24	9.01	3500	140
208 FAYETTEVILLE-SPRINGD	5.25	0	0	7	1	33.99	2.64	18.32	54.94	9.56	1809	125
209 COLORADO SPRINGS CO	5.25	0	0	7	1	33.55	2.60	18.08	54.24	9.68	2710	145
210 EAU CLAIRE WI	5.25	0	0	7	1	33.04	2.56	17.81	53.41	9.83	1665	119
211 WAUSAU WI	5.25	0	0	7	1	32.65	2.53	17.60	52.78	9.95	1586	115
212 CORPUS CHRISTI TX	5.25	0	0	7	1	32.45	2.52	17.49	52.45	10.01	1526	113
213 LAKELAND-WINTER HAVE	5.25	0	0	7	1	31.93	2.48	17.21	51.62	10.17	1858	127
214 AMARILLO TX	5.25	0	0	7	1	30.62	2.38	16.50	49.50	10.61	1812	125
215 BILOXI-GULFPORT MS	5.25	0	0	7	1	29.95	2.32	16.14	48.42	10.84	1515	112
216 SPOKANE WA	5.25	0	0	7	1	28.15	2.18	15.17	45.50	11.54	1758	123
217 TACOMA WA	5.25	0	0	7	1	27.75	2.15	14.96	44.86	11.70	1676	119
218 MCALLEN-PHARR-EDINBU	5.25	0	0	7	1	27.04	2.10	14.58	43.72	12.01	1543	113
219 * UTAH	5.25	0	0	7	0	20.65	1.60	11.13	33.39	15.72	3	
220 * MONTANA	5.25	0	0	7	0	18.77	1.46	10.11	30.33	17.31	2	

TABLE J-4

.999 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
221 UTICA-ROME NY	4.50	0	0	6	1	47.13	3.66	25.40	76.19	5.91	2658	145
222 APPLETON-OSHKOSH WI	4.50	0	0	6	1	41.60	3.23	22.42	67.25	6.69	1404	172
223 FORT SMITH AR-OK	4.50	0	0	6	1	37.70	2.93	20.32	60.95	7.38	3379	142
224 KILLEEN-TEMPLE TX	4.50	0	0	6	1	31.44	2.44	16.95	50.83	8.85	2090	134
225 ALEXANDRIA LA	4.50	0	0	6	1	30.98	2.40	16.69	50.07	8.99	1988	131
226 WICHITA FALLS TX	4.50	0	0	6	1	30.44	2.36	16.41	49.21	9.14	1713	121
227 FARGO-MOORHEAD ND-MN	4.50	0	0	6	1	29.03	2.25	15.65	46.93	9.59	2794	146
228 OCALA FL	4.50	0	0	6	1	28.39	2.20	15.30	45.90	9.80	1599	116
229 * OHIO	4.50	0	0	6	0	69.89	5.42	37.67	112.98	3.98	7	
230 * ILLINOIS	4.50	0	0	6	0	47.36	3.67	25.52	76.56	5.88	6	
231 * MASSACHUSETTS	4.50	0	0	6	0	46.78	3.63	25.21	75.62	5.95	4	
232 * IOWA	4.50	0	0	6	0	38.27	2.97	20.63	61.86	7.27	4	
233 BAKERSFIELD CA	4.50	0	0	6	0	34.26	2.66	18.46	55.38	8.13	3500	140
234 SANTA BARBARA-SANTA	4.50	0	0	6	0	31.99	2.48	17.24	51.71	8.70	2737	145
235 MODESTO CA	4.50	0	0	6	0	27.78	2.16	14.97	44.90	10.02	1511	112
236 ROANOKE VA	3.75	0	0	5	2	46.76	3.63	25.20	75.59	4.96	1187	205
237 LYNCHBURG VA	3.75	0	0	5	1	41.87	3.25	22.56	67.68	5.54	1368	179
238 MACON GA	3.75	0	0	5	1	39.93	3.10	21.52	64.55	5.81	1400	173
239 SPRINGFIELD MO	3.75	0	0	5	1	38.63	3.00	20.82	62.44	6.01	1244	199
240 SAVANNAH GA	3.75	0	0	5	1	37.98	2.95	20.47	61.39	6.11	1368	179
241 TALLAHASSEE FL	3.75	0	0	5	1	35.18	2.73	18.96	56.87	6.59	1271	195
242 TUSCALOOSA AL	3.75	0	0	5	1	33.75	2.62	18.19	54.55	6.87	1333	185
243 TEXARKANA TX-AR	3.75	0	0	5	1	30.95	2.40	16.68	50.04	7.49	2000	131
244 ST CLOUD MN	3.75	0	0	5	1	29.10	2.26	15.69	47.05	7.97	2175	136
245 ABILENE TX	3.75	0	0	5	1	28.45	2.21	15.34	46.00	8.15	2724	145
246 OXNARD-SIMI VALLEY-V	3.75	0	0	5	1	27.01	2.10	14.56	43.66	8.59	1864	127
247 PUEBLO CO	3.75	0	0	5	1	25.78	2.00	13.89	41.67	9.00	2405	141
248 SAN ANGELO TX	3.75	0	0	5	1	24.69	1.92	13.30	39.91	9.40	1500	150
249 FORT COLLINS CO	3.75	0	0	5	1	24.62	1.91	13.27	39.80	9.42	2610	144
250 GRAND FORKS ND-MN	3.75	0	0	5	1	24.44	1.90	13.17	39.51	9.49	3451	141
251 GREELEY CO	3.75	0	0	5	1	23.95	1.86	12.91	38.71	9.69	3500	140
252 PROVO-OREM UT	3.75	0	0	5	1	23.93	1.86	12.90	38.68	9.70	2014	132
253 BILLINGS MT	3.75	0	0	5	1	22.74	1.76	12.25	36.75	10.20	2642	145
254 * INDIANA	3.75	0	0	5	0	45.10	3.50	24.31	72.90	5.14	5	
255 FALL RIVER MA-RI	3.75	0	0	5	0	37.45	2.91	20.18	60.53	6.19	1975	131
256 * GEORGIA	3.75	0	0	5	0	34.47	2.67	18.58	55.72	6.73	5	
257 RENO NV	3.75	0	0	5	0	28.24	2.19	15.22	45.65	8.22	3500	140
258 SANTA ROSA CA	3.75	0	0	5	0	24.80	1.92	13.36	40.08	9.36	1604	116
259 EUGENE-SPRINGFIELD O	3.75	0	0	5	0	24.58	1.91	13.25	39.74	9.44	3500	140
260 LAREDO TX	3.75	0	0	5	0	22.77	1.77	12.27	36.81	10.19	3306	143
261 VALLEJO-FAIRFIELD-NA	3.75	0	0	5	0	22.65	1.76	12.21	36.61	10.24	1611	117
262 BISMARK ND	3.75	0	0	5	0	22.53	1.75	12.14	36.42	10.30	3500	140
263 SALEM OR	3.75	0	0	5	0	22.11	1.72	11.92	35.74	10.49	1902	128
264 CASPER WY	3.75	0	0	5	0	21.94	1.70	11.83	35.47	10.57	3500	140
265 LAS CRUCES NM	3.75	0	0	5	0	21.52	1.67	11.60	34.79	10.78	3500	140
266 YAKIMA WA	3.75	0	0	5	0	21.28	1.65	11.47	34.41	10.90	3500	140
267 GREAT FALLS MT	3.75	0	0	5	0	20.10	1.56	10.83	32.48	11.54	2661	145
268 NEWBRGH-MIDDLETOWN N	3.00	0	0	4	2	46.86	3.64	25.26	75.75	3.96	833	213
269 WILLIAMSPORT PA	3.00	0	0	4	1	45.76	3.55	24.66	73.98	4.06	1215	202
270 PARKERSBURG-MARIETTA	3.00	0	0	4	1	43.50	3.38	23.44	70.32	4.27	1244	199
271 CHARLOTTESVILLE VA	3.00	0	0	4	1	41.13	3.19	22.17	66.49	4.51	1191	205
272 SHARON PA	3.00	0	0	4	1	40.14	3.11	21.63	64.87	4.62	670	197
273 * CONNECTICUT	3.00	0	0	4	0	42.47	3.30	22.89	68.66	4.37	4	
274 * WISCONSIN	3.00	0	0	4	0	35.20	2.73	18.97	56.91	5.27	4	
275 * ALABAMA	3.00	0	0	4	0	31.95	2.48	17.22	51.65	5.81	4	

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.999 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
276 * SOUTH CAROLINA	3.00	0	0	4	0	30.85	2.39	16.63	49.87	6.02	5	
277 * ARKANSAS	3.00	0	0	4	0	30.05	2.33	16.20	48.59	6.17	4	
278 * LOUISIANA	3.00	0	0	4	0	29.59	2.30	15.95	47.84	6.27	4	
279 * OREGON	3.00	0	0	4	0	24.85	1.93	13.39	40.17	7.47	4	
280 * COLORADO	3.00	0	0	4	0	24.22	1.88	13.05	39.15	7.66	4	
281 * NEW MEXICO	3.00	0	0	4	0	21.39	1.66	11.53	34.58	8.68	5	
282 * ARIZONA	3.00	0	0	4	0	20.83	1.62	11.23	33.67	8.91	3	
283 * WASHINGTON	3.00	0	0	4	0	19.17	1.49	10.33	30.98	9.68	3	
284 KALAMAZOO-PORTAGE MI	2.25	0	0	3	2	50.47	3.92	27.20	81.59	2.76	1165	208
285 SPRINGFIELD IL	2.25	0	0	3	2	46.32	3.59	24.96	74.87	3.01	1170	205
286 CHAMPAIGN-URBANA-RAN	2.25	0	0	3	2	45.14	3.50	24.33	72.97	3.08	1000	217
287 BATTLE CREEK MI	2.25	0	0	3	2	44.45	3.45	23.96	71.86	3.13	1263	196
288 JACKSON MI	2.25	0	0	3	2	43.00	3.34	23.18	69.51	3.24	698	200
289 WHEELING WV-OH	2.25	0	0	3	1	43.83	3.40	23.62	70.86	3.18	944	217
290 STATE COLLEGE PA	2.25	0	0	3	1	43.81	3.40	23.61	70.81	3.18	1115	212
291 CUMBERLAND MD-WV	2.25	0	0	3	1	42.65	3.31	22.99	68.94	3.26	758	207
292 MUSKEGON-NORTON SHOR	2.25	0	0	3	1	42.33	3.28	22.81	68.43	3.29	1037	216
293 KOKOMO IN	2.25	0	0	3	1	40.51	3.14	21.83	65.48	3.44	554	178
294 DECATUR IL	2.25	0	0	3	1	40.20	3.12	21.67	64.99	3.46	578	182
295 ASHEVILLE NC	2.25	0	0	3	1	40.15	3.12	21.64	64.90	3.47	1107	212
296 SALISBURY-CONCORD NC	2.25	0	0	3	1	39.77	3.07	21.44	64.30	3.50	1258	197
297 BLOOMINGTON-NORMAL I	2.25	0	0	3	1	38.52	2.99	20.76	62.27	3.61	1173	207
298 JANESVILLE-BELIOT WI	2.25	0	0	3	1	38.17	2.96	20.57	61.70	3.65	721	203
299 HICKORY NC	2.25	0	0	3	1	37.40	2.90	20.16	60.46	3.72	653	194
300 CLARKSVILLE-HOPKINSV	2.25	0	0	3	1	37.33	2.90	20.12	60.35	3.73	1264	196
301 OWENSBORO KY	2.25	0	0	3	1	36.45	2.83	19.65	58.93	3.82	462	158
302 DUBUQUE IA	2.25	0	0	3	1	35.61	2.76	19.19	57.56	3.91	612	188
303 BURLINGTON VT	2.25	0	0	3	1	34.43	2.67	18.55	55.65	4.04	417	147
304 LEXINGTON-FAYETTE KY	1.50	0	0	2	2	53.06	4.12	28.59	85.77	1.75	1493	280
305 SPRINGFIELD OH	1.50	0	0	2	2	43.32	3.36	23.35	70.03	2.14	834	213
306 PETERSBURG-COLONIAL	1.50	0	0	2	1	38.82	3.01	20.92	62.75	2.39	808	211
307 ANDERSON SC	1.50	0	0	2	1	36.54	2.84	19.70	59.07	2.54	749	206
308 ATHENS GE	1.50	0	0	2	1	35.72	2.77	19.25	57.75	2.60	929	217
309 KANKAKEE IL	1.50	0	0	2	1	35.27	2.74	19.01	57.01	2.63	678	198
310 FLORENCE AL	1.50	0	0	2	1	34.89	2.71	18.81	56.41	2.66	1258	197
311 FORENCE SC	1.50	0	0	2	1	34.24	2.66	18.45	55.35	2.71	805	211
312 WILMINGTON NC	1.50	0	0	2	1	34.04	2.64	18.35	55.03	2.73	1040	216
313 ROCK HILL SC	1.50	0	0	2	1	33.82	2.62	18.23	54.67	2.74	684	199
314 JACKSONVILLE NC	1.50	0	0	2	1	33.27	2.58	17.93	53.77	2.79	765	208
315 COLUMBIA MO	1.50	0	0	2	1	33.02	2.56	17.79	53.37	2.81	685	199
316 IOWA CITY IW	1.50	0	0	2	1	32.99	2.56	17.78	53.33	2.81	619	189
317 JOPLIN MO	1.50	0	0	2	1	32.35	2.51	17.44	52.30	2.87	1271	195
318 WACO TX	1.50	0	0	2	1	32.12	2.49	17.31	51.92	2.89	1000	217
319 GAINESVILLE FL	1.50	0	0	2	1	31.98	2.48	17.24	51.71	2.90	916	216
320 TYLER TX	1.50	0	0	2	1	31.21	2.42	16.82	50.45	2.97	934	217
321 LONGVIEW TX	1.50	0	0	2	1	31.12	2.41	16.77	50.31	2.98	1175	207
322 ST JOSEPH MO	1.50	0	0	2	1	30.63	2.38	16.51	49.51	3.03	840	213
323 SIOUX CITY NE-IA	1.50	0	0	2	1	30.58	2.37	16.48	49.43	3.03	1126	211
324 LAKE CHARLES LA	1.50	0	0	2	1	30.57	2.37	16.47	49.41	3.04	1105	212
325 PINE BLUFF AR	1.50	0	0	2	1	30.08	2.33	16.21	48.63	3.08	873	215
326 PORTSMOUTH-DOVER-ROC	1.50	0	0	2	1	29.96	2.32	16.15	48.44	3.10	496	166
327 LAWTON OK	1.50	0	0	2	1	29.25	2.27	15.76	47.28	3.17	1084	214
328 PASCAGOULA-MOSS POIN	1.50	0	0	2	1	29.00	2.25	15.63	46.87	3.20	736	205
329 FORT WALTON BEACH FL	1.50	0	0	2	1	28.97	2.25	15.61	46.83	3.20	944	217
330 PANAMA CITY FL	1.50	0	0	2	1	28.30	2.20	15.25	45.74	3.28	747	206

TABLE J-4

.999 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
331 BRYAN-COLLEGE STATIO	1.50	0	0	2	1	27.76	2.15	14.96	44.87	3.34	585	183
332 ENID OK	1.50	0	0	2	1	27.00	2.10	14.55	43.65	3.44	1054	215
333 SHERMAN-DENISON TX	1.50	0	0	2	1	27.00	2.09	14.55	43.64	3.44	940	217
334 BRADENTON FL	1.50	0	0	2	1	26.90	2.09	14.50	43.48	3.45	739	205
335 BANGOR ME	1.50	0	0	2	1	26.84	2.08	14.47	43.39	3.46	350	129
336 STOCKTON CA	1.50	0	0	2	1	26.23	2.04	14.14	42.40	3.54	1412	170
337 ODESSA TX	1.50	0	0	2	1	25.56	1.98	13.78	41.33	3.63	907	216
338 MIDLAND TX	1.50	0	0	2	1	25.35	1.97	13.66	40.98	3.66	939	217
339 BOISE CITY ID	1.50	0	0	2	1	24.76	1.92	13.34	40.02	3.75	1043	216
340 VICTORIA TX	1.50	0	0	2	1	24.53	1.90	13.[illegible]	39.66	3.78	892	216
341 BROWNSVILLE-HARLINGE	1.50	0	0	2	1	23.74	1.84	12.[illegible]	38.38	3.91	896	216
342 SANTA CRUZ CA	1.50	0	0	2	1	22.49	1.75	12.12	36.36	4.13	440	153
343 BREMERTON WA	1.50	0	0	2	1	18.66	1.45	10.05	30.16	4.97	393	141
344 DANVILLE VA	1.50	0	0	2	0	36.38	2.82	19.61	58.81	2.55	1018	216
345 VISALIA-TULARE-PORTE	1.50	0	0	2	0	27.89	2.16	15.03	45.09	3.33	3500	140
346 SALINAS-SEASIDE-MONT	1.50	0	0	2	0	26.44	2.05	14.25	42.74	3.51	3324	143
347 CHICO CA	1.50	0	0	2	0	22.92	1.78	12.35	37.05	4.05	1645	118
348 YUBA CITY CA	1.50	0	0	2	0	21.84	1.69	11.77	35.30	4.25	1776	124
349 REDDING CA	1.50	0	0	2	0	20.98	1.63	11.30	33.91	4.42	3500	140
350 RICHLAND-KENNEWICK W	1.50	0	0	2	0	20.52	1.59	11.06	33.17	4.52	2975	146
351 MEDFORD OR	1.50	0	0	2	0	20.31	1.58	10.95	32.84	4.57	2812	146
352 BELLINGHAM WA	1.50	0	0	2	0	18.59	1.44	10.02	30.05	4.99	2126	135
353 OLYMPIA WA	0.75	0	0	1	1	18.00	1.40	9.70	29.09	2.58	714	202
354 * NORTH CAROLINA	0.75	0	0	1	0	38.04	2.95	20.50	61.49	1.22	5	
355 * IDAHO	0.75	0	0	1	0	19.38	1.50	10.44	31.33	2.39	5	
356 * WEST VIRGINIA	0.00	0	0	0	0	45.57	3.54	24.56	73.67	0.00		
357 * MICHIGAN	0.00	0	0	0	0	44.57	3.46	24.02	72.06	0.00	6	
358 * RHODE ISLAND	0.00	0	0	0	0	41.38	3.21	22.30	66.89	0.00		
359 * DELAWARE	0.00	0	0	0	0	41.34	3.21	22.28	66.83	0.00	1	
360 * NEW HAMPSHIRE	0.00	0	0	0	0	32.90	2.55	17.73	53.19	0.00		
361 * VERMONT	0.00	0	0	0	0	31.91	2.48	17.20	51.58	0.00		
362 * MAINE	0.00	0	0	0	0	25.76	2.00	13.89	41.65	0.00		
363 * WYOMING	0.00	0	0	0	0	20.35	1.58	10.97	32.89	0.00	1	
364 * NEVADA	0.00	0	0	0	0	19.51	1.51	10.52	31.55	0.00	1	
	5924.96	7	473	5764	350	19748.80	1532.40	10643.79	31925.00	18.56		

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.995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
1 NEW YORK NY-NJ	627.85	1	109	358	4	771.43	58.45	413.76	1243.63	50.49	1384	237
2 CHICAGO IL	283.70	2	43	155	6	478.29	36.24	256.53	771.07	36.79	3500	140
3 LOS ANGELES-LONG BEA	194.00	2	25	111	5	313.99	23.79	168.41	506.19	38.33	3500	140
4 PHILADELPHIA PA-NJ	144.00	0	15	127	4	276.39	20.94	148.25	445.58	32.32	3500	140
5 DETROIT MI	139.65	0	11	140	3	252.77	19.15	135.57	407.49	34.27	3500	140
6 WASHINGTON DC-MD	125.85	0	9	130	2	237.34	17.98	127.30	382.63	32.89	2812	146
7 BOSTON MA	88.95	0	3	106	3	171.43	12.99	91.95	276.37	32.19	1233	200
8 MINNEAPOLIS-ST PAUL	78.15	0	6	79	3	153.55	11.63	82.36	247.54	31.57	3500	140
9 HOUSTON TX	76.80	0	7	73	3	162.40	12.30	87.10	261.81	29.33	3500	140
10 ST LOUIS MO-IL	75.90	0	6	76	2	142.87	10.82	76.63	230.32	32.95	3500	140
11 NASSAU-SUFFOLK NY	72.30	0	2	88	2	152.28	11.54	81.68	245.50	29.45	1218	202
12 CLEVELAND OH	69.90	0	6	68	2	153.13	11.60	82.13	246.86	28.32	1519	112
13 MILWAUKEE WI	67.95	0	3	78	2	121.78	9.23	65.32	196.33	34.61	1455	161
14 DALLAS-FORT WORTH TX	65.40	0	6	62	3	140.83	10.67	75.53	227.03	28.81	3500	140
15 BALTIMORE MD	65.40	0	6	62	2	159.74	12.10	85.68	257.52	25.40	2259	138
16 NEWARK NJ	65.25	0	0	87	2	117.58	8.91	63.06	189.55	34.42	1008	217
17 ATLANTA GA	64.65	0	6	61	2	144.98	10.99	77.76	233.72	27.66	3500	140
18 PITTSBURGH PA	62.40	0	6	58	2	161.07	12.20	86.39	259.67	24.03	3049	146
19 SAN FRANCISCO-OAKLAN	59.25	0	5	58	2	115.94	8.78	62.18	186.90	31.70	2480	143
20 CINCINNATI OH-KY	52.20	0	3	57	2	120.45	9.13	64.60	194.18	26.88	2149	136
21 DENVER-BOULDER CO	50.25	0	5	46	1	96.39	7.30	51.70	155.40	32.34	3500	140
22 MIAMI FL	48.75	0	5	44	1	83.20	6.30	44.62	134.13	36.35	2042	133
23 JERSEY CITY NJ	45.75	0	10	19	0	51.30	3.89	27.52	82.71	55.31	47	21
24 * NEW YORK	40.50	0	0	54	0	156.43	11.85	83.90	252.18	16.06	6	
25 INDIANAPOLIS IN	35.55	0	2	39	2	105.82	8.02	56.76	170.60	20.84	3072	145
26 MERIDEN CT	31.65	0	6	17	0	37.28	2.82	20.00	60.10	52.66	24	24
27 BUFFALO NY	30.30	0	2	32	2	90.20	6.83	48.38	145.42	20.84	1590	116
28 COLUMBUS OH	29.55	0	2	31	2	97.57	7.54	53.40	160.52	18.41	2459	142
29 LOUISVILLE KY-IN	29.25	0	0	39	2	86.05	6.52	46.16	138.73	21.08	1392	174
30 NEW HAVEN-WEST HAVEN	29.25	0	0	39	1	67.38	5.11	36.14	108.63	26.93	337	125
31 KANSAS CITY MO-KS	28.80	0	2	30	2	95.49	7.23	51.21	153.94	18.71	3341	143
32 NEW ORLEANS LA	28.05	0	2	29	1	77.63	5.88	41.64	125.15	22.41	1966	130
33 BRIDGEPORT CT	26.25	0	0	35	0	56.74	4.30	30.43	91.47	28.70	198	120
34 TAMPA-ST PETERSBURG	25.80	0	2	26	1	67.10	5.08	35.99	108.17	23.85	2045	133
35 BRISTOL CT	25.35	0	4	17	0	37.18	2.82	19.94	59.95	42.29	79	34
36 SAN DIEGO CA	25.05	0	2	25	1	71.30	5.40	38.24	114.94	21.79	3500	140
37 OKLAHOMA CITY OK	25.05	0	2	25	1	69.17	5.24	37.10	111.51	22.46	3471	140
38 PHOENIX AZ	25.05	0	2	25	1	65.67	4.98	35.22	105.87	23.66	3500	140
39 MEMPHIS TN-AR	24.90	0	1	29	2	73.74	5.59	39.55	118.87	20.95	2298	139
40 HARTFORD CT	24.75	0	0	33	2	78.81	5.97	42.27	127.05	19.48	1032	216
41 PROVIDENCE-WARWICK-P	24.75	0	0	33	2	70.28	5.32	37.69	113.29	21.85	747	206
42 NEW BRUNSWICK-PERTH	23.25	0	0	31	1	55.40	4.20	29.71	89.31	26.03	312	118
43 SEATTLE-EVERETT WA	22.80	0	2	22	1	60.34	4.57	32.36	97.28	23.44	3500	140
44 DAYTON OH	22.05	0	2	21	2	76.78	5.82	41.18	123.79	17.81	1707	121
45 NASHVILLE-DAVIDSON T	21.15	0	1	24	2	76.01	5.76	40.77	122.54	17.26	3500	140
46 CHARLOTTE-GASTONIA N	21.15	0	1	24	2	67.82	5.14	36.37	109.33	19.35	1525	113
47 NORWALK CT	19.20	0	3	13	0	30.99	2.35	16.62	49.96	38.43	88	38
48 OMAHA NE-IA	18.90	0	1	21	1	54.92	4.16	29.46	88.54	21.35	1537	113
49 SPRINGFIELD-CHICOPEE	18.75	0	0	25	2	60.22	4.56	32.30	97.09	19.31	633	191
50 LONG BRANCH-ASBURY P	18.75	0	0	25	0	50.22	3.80	26.93	80.95	23.16	476	161
51 BURLINGTON NC	18.75	0	0	25	0	46.56	3.53	24.97	75.06	24.98	428	150
52 NEW BRITAIN CT	18.30	0	2	16	0	39.36	2.98	21.11	63.45	28.84	119	50
53 STAMFORD CT	18.30	0	2	16	0	36.54	2.77	19.60	58.90	31.07	121	51
54 BIRMINGHAM AL	18.15	0	1	20	1	69.22	5.25	37.13	111.60	16.26	3358	142
55 NORTHEAST PENNSYLVAN	17.40	0	1	17	2	72.64	5.50	38.96	117.10	14.86	1951	130

TABLE J-5

.995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
56 HARRISBURG PA	17.40	0	1	19	2	65.34	4.95	35.04	105.33	16.52	1624	117
57 ROCHESTER NY	17.25	0	0	23	2	78.32	5.93	42.01	126.26	13.66	2766	146
58 ALBANY-SCHENECTADY-T	17.25	0	0	23	2	73.18	5.55	39.25	117.98	14.62	2624	144
59 RICHMOND VA	17.25	0	0	23	2	72.73	5.51	39.01	117.25	14.71	2145	136
60 ANAHEIM-SANTA ANA-GA	17.25	0	0	23	1	51.75	3.92	27.76	83.43	20.68	782	209
61 SAN JOSE CA	17.25	0	0	23	1	51.61	3.91	27.68	83.20	20.73	1300	191
62 FORT LAUDERDALE-HOLL	17.25	0	0	23	1	45.31	3.43	24.30	73.04	23.62	1219	202
63 * PENNSYLVANIA	17.25	0	0	23	0	87.10	6.60	46.71	140.41	12.29	7	
64 TULSA OK	15.90	0	1	17	1	60.06	4.55	32.22	96.83	16.42	3500	140
65 JACKSONVILLE FL	15.90	0	1	17	1	55.62	4.21	29.83	89.66	17.73	3199	144
66 SAN ANTONIO TX	15.90	0	1	17	1	55.19	4.18	29.60	88.98	17.87	2527	143
67 ALLENTOWN-BETHLEHEM-	15.75	0	0	21	2	64.90	4.92	34.81	104.63	15.05	1490	152
68 PORTLAND OR-WA	15.15	0	1	16	1	51.32	3.89	27.52	82.73	18.31	3500	140
69 SALT LAKE CITY-OGDEN	15.15	0	1	16	1	47.11	3.57	25.27	75.94	19.95	3500	140
70 BROCKTON MA	15.15	0	1	16	0	32.32	2.45	17.33	52.10	29.08	137	57
71 NORFOLK-VIRGINIA BEA	14.25	0	0	19	2	66.94	5.07	35.90	107.91	13.21	1337	341
72 GRAND RAPIDS MI	14.25	0	0	19	2	63.06	4.78	33.82	101.66	14.02	1420	169
73 COLUMBIA SC	13.50	0	0	18	1	51.35	3.89	27.54	82.79	16.31	1465	158
74 * NEW JERSEY	13.50	0	0	18	0	52.23	3.96	28.02	84.21	16.03	3	
75 LITTLE ROCK-NORTH LI	12.00	0	0	16	1	46.23	3.50	24.80	74.53	16.10	1489	153
76 TOLEDO OH-MI	11.25	0	0	15	2	69.24	5.25	37.14	111.62	10.08	2107	137
77 AUSTIN TX	11.25	0	0	15	1	45.90	3.48	24.62	73.99	15.21	2766	145
78 WICHITA KS	11.25	0	0	15	1	44.76	3.39	24.01	72.16	15.59	2448	142
79 ORLANDO FL	11.25	0	0	15	1	44.53	3.37	23.88	71.78	15.67	2528	143
80 TRENTON NJ	11.25	0	0	15	1	43.25	3.28	23.20	69.73	16.13	228	90
81 PATERSON-CLIFTON-PAS	11.25	0	0	15	0	43.55	3.30	23.36	70.21	16.02	192	78
82 LOWELL MA-NH	11.25	0	0	15	0	36.22	2.74	19.43	58.39	19.27	179	73
83 NASHUA NH	11.25	0	0	15	0	33.27	2.52	17.85	53.64	20.97	154	64
84 FITCHBURG-LEOMINSTER	11.25	0	0	15	0	31.36	2.38	16.82	50.56	22.25	167	69
85 LAFAYETTE LA	11.25	0	0	15	0	28.28	2.14	15.17	45.57	24.68	283	109
86 AKRON OH	10.50	0	0	14	2	65.82	4.99	35.30	106.11	9.90	903	216
87 WILMINGTON DE-NJ	10.50	0	0	14	2	61.56	4.66	33.02	99.25	10.58	1165	208
88 SYRACUSE NY	10.50	0	0	14	2	61.43	4.65	32.95	99.04	10.60	2419	142
89 MADISON WI	10.50	0	0	14	2	50.50	3.83	27.08	81.40	12.90	1198	204
90 BATON ROUGE LA	9.90	0	1	9	1	43.75	3.32	23.47	70.53	14.04	1617	117
91 DES MOINES IA	9.75	0	0	13	1	49.25	3.73	26.41	79.39	12.28	1136	210
92 WORCESTER MA	9.75	0	0	13	1	44.96	3.41	24.11	72.48	13.45	558	178
93 WATERBURY CT	9.75	0	0	13	1	44.49	3.37	23.86	71.72	13.59	257	100
94 EL PASO TX	9.75	0	0	13	1	31.18	2.36	16.72	50.26	19.40	1057	215
95 LORAIN-ELYRIA OH	9.75	0	0	13	0	41.28	3.13	22.14	66.55	14.65	495	166
96 ELMIRA NY	9.75	0	0	13	0	38.39	2.91	20.59	61.89	15.75	415	147
97 PITTSFIELD MA	9.75	0	0	13	0	37.64	2.85	20.19	60.69	16.07	213	85
98 GALVESTON-TEXAS CITY	9.75	0	0	13	0	25.19	1.91	13.51	40.61	24.01	399	142
99 YOUNGSTOWN-WARREN OH	9.00	0	0	12	2	51.34	3.89	27.54	82.77	10.87	1023	216
100 READING PA	9.00	0	0	12	2	50.84	3.85	27.27	81.97	10.98	862	215
101 POUGHKEEPSIE NY	9.00	0	0	12	2	49.71	3.77	26.66	80.13	11.23	813	212
102 CANTON OH	9.00	0	0	12	2	49.41	3.74	26.50	79.66	11.30	965	217
103 ERIE PA	9.00	0	0	12	1	47.31	3.58	25.37	76.27	11.80	813	212
104 STEUBENVILLE-WEIRTON	9.00	0	0	12	0	39.85	3.02	21.37	64.24	14.01	582	183
105 ALTOONA PA	9.00	0	0	12	0	39.57	3.00	21.22	63.79	14.11	530	173
106 VINELAND-MILLVILLE-B	9.00	0	0	12	0	39.39	2.98	21.13	63.51	14.17	500	167
107 MANSFIELD OH	9.00	0	0	12	0	39.20	2.97	21.02	63.17	14.24	496	166
108 GREENSBORO-WINSTON-S	8.25	0	0	11	2	64.55	4.89	34.62	104.07	7.93	3213	144
109 LANSING-EAST LANSING	8.25	0	0	11	2	61.33	4.65	32.89	98.87	8.34	2277	139
110 FORT WAYNE IN	8.25	0	0	11	2	56.13	4.25	30.10	90.48	9.12	1750	122

TABLE [illegible]

.995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
111 RALEIGH-DURHAM NC	8.25	0	0	11	2	55.71	4.22	29.88	89.81	9.19	1553	114
112 KNOXVILLE TN	8.25	0	0	11	2	53.18	4.03	28.52	85.74	9.62	1630	117
113 GARY-HAMMOND-EAST CH	8.25	0	0	11	2	50.45	3.82	27.06	81.34	10.14	737	217
114 PEORIA IL	8.25	0	0	11	1	48.84	3.70	26.20	78.74	10.48	1803	125
115 DAVENPORT-ROCK ISLAN	8.25	0	0	11	1	44.55	3.38	23.89	71.82	11.49	1704	121
116 FAYETTEVILLE NC	8.25	0	0	11	1	39.45	2.99	21.16	63.60	12.97	654	194
117 NEW BEDFORD MA	8.25	0	0	11	0	37.12	2.81	19.91	59.84	13.79	206	83
118 GREEN BAY WI	8.25	0	0	11	0	35.02	2.65	18.78	56.45	14.61	524	172
119 GREENVILLE-SPARTANBU	7.50	0	0	10	1	50.67	3.84	27.18	81.69	9.18	2115	135
120 CHATTANOOGA TN-GA	7.50	0	0	10	1	49.59	3.76	26.60	79.94	9.38	2109	135
121 JOHNSTOWN PA	7.50	0	0	10	1	45.10	3.42	24.19	72.70	10.32	1770	123
122 AUGUSTA GA-SC	7.50	0	0	10	1	41.46	3.14	22.24	66.84	11.22	1700	120
123 LINCOLN NE	7.50	0	0	10	1	35.36	2.68	18.96	57.00	13.16	845	214
124 SARASOTA FL	7.50	0	0	10	1	27.18	2.06	14.58	43.81	17.12	587	184
125 * VIRGINIA	7.50	0	0	10	0	56.11	4.25	30.10	90.46	8.29	5	
126 MANCHESTER NH	7.50	0	0	10	0	37.75	2.86	20.25	60.86	12.32	258	101
127 * NEBRASKA	7.50	0	0	10	0	27.14	2.06	14.56	43.76	17.14	2	
128 * OKLAHOMA	7.50	0	0	10	0	25.47	1.93	13.66	41.07	18.26	3	
129 JOHNSON CITY-KINGSPO	6.75	0	0	9	1	49.12	3.72	26.35	79.19	8.52	2866	146
130 LIMA OH	6.75	0	0	9	0	43.82	3.32	23.50	70.64	9.56	1705	121
131 HUNTINGTON-ASHLAND W	6.75	0	0	9	0	43.45	3.29	23.30	70.04	9.64	1756	123
132 SACRAMENTO CA	6.00	0	0	8	1	48.16	3.65	25.83	77.63	7.73	3434	141
133 EVANSVILLE IN-KY	6.00	0	0	8	1	43.46	3.29	23.31	70.07	8.56	1975	131
134 CHARLESTON-NORTH CHA	6.00	0	0	8	1	42.78	3.24	22.95	68.97	8.70	2618	144
135 HUNTSVILLE AL	6.00	0	0	8	1	42.02	3.18	22.54	67.74	8.86	1919	129
136 JACKSON MS	6.00	0	0	8	1	41.91	3.18	22.48	67.56	8.88	1651	118
137 SHREVEPORT LA	6.00	0	0	8	1	39.09	2.96	20.96	63.01	9.52	2363	141
138 LAWRENCE-HAVERHILL M	6.00	0	0	8	1	38.05	2.88	20.41	61.34	9.78	305	116
139 MONTGOMERY AL	6.00	0	0	8	1	38.00	2.88	20.38	61.27	9.79	2013	132
140 * CALIFORNIA	6.00	0	0	8	0	37.70	2.86	20.22	60.77	9.87	5	
141 * TEXAS	6.00	0	0	8	0	36.34	2.75	19.49	58.58	10.24	4	
142 DANBURY CT	6.00	0	0	8	0	31.66	2.40	16.98	51.04	11.76	255	100
143 LEWISTON-AUBURN ME	6.00	0	0	8	0	27.40	2.08	14.69	44.17	13.59	102	96
144 RIVERSIDE-SAN BERNAR	5.25	0	0	7	1	39.21	2.97	21.03	63.21	8.31	3500	140
145 MOBILE AL	5.25	0	0	7	1	38.86	2.94	20.84	62.64	8.38	2818	146
146 DULUTH-SUPERIOR MN-W	5.25	0	0	7	1	36.24	2.75	19.44	58.43	8.99	3500	140
147 WEST PALM BEACH-BOCA	5.25	0	0	7	1	35.86	2.72	19.23	57.81	9.08	2023	132
148 ALBUQUERQUE NM	5.25	0	0	7	1	35.09	2.66	18.82	56.57	9.28	3500	140
149 TOPEKA KS	5.25	0	0	7	1	33.86	2.57	18.16	54.59	9.62	1764	123
150 PENSACOLA FL	5.25	0	0	7	1	33.04	2.50	17.72	53.26	9.86	1697	120
151 TUCSON AZ	5.25	0	0	7	1	32.55	2.47	17.46	52.48	10.00	3500	140
152 COLORADO SPRINGS CO	5.25	0	0	7	1	30.31	2.30	16.26	48.87	10.74	2710	145
153 CORPUS CHRISTI TX	5.25	0	0	7	1	29.32	2.22	15.72	47.26	11.11	1526	113
154 * KENTUCKY	5.25	0	0	7	0	47.49	3.60	25.47	76.56	6.86	4	
155 * TENNESSEE	5.25	0	0	7	0	46.18	3.50	24.77	74.44	7.05	4	
156 * MINNESOTA	5.25	0	0	7	0	44.69	3.39	23.97	72.04	7.29	7	
157 * SOUTH DAKOTA	5.25	0	0	7	0	20.61	1.56	11.06	33.23	15.80	2	
158 * NORTH DAKOTA	5.25	0	0	7	0	19.98	1.51	10.72	32.21	16.30	2	
159 YORK PA	4.50	0	0	6	2	51.48	3.90	27.61	83.00	5.42	1435	165
160 BINGHAMTON NY-PA	4.50	0	0	6	1	46.24	3.50	24.80	74.55	6.04	2071	134
161 LAS VEGAS NV	4.50	0	0	6	1	36.80	2.79	19.78	59.46	7.57	3500	140
162 PORTLAND ME	4.50	0	0	6	1	34.13	2.59	18.31	55.02	8.18	367	134
163 RACINE WI	4.50	0	0	6	1	33.69	2.55	18.07	54.32	8.28	337	125
164 BEAUMONT-PORT ARTHUR	4.50	0	0	6	1	33.36	2.53	17.89	53.79	8.37	2207	137
165 KENOSHA WI	4.50	0	0	6	1	30.79	2.33	16.51	49.63	9.07	272	105

TABLE J-5

1995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
166 FAYETTEVILLE-SPRINGD	4.50	0	0	6	1	30.71	2.33	16.47	49.50	9.09	1809	125
167 LAKELAND-WINTER HAVE	4.50	0	0	6	1	28.85	2.19	15.47	46.51	9.68	1858	127
168 AMARILLO TX	4.50	0	0	6	1	27.67	2.10	14.84	44.60	10.09	1812	125
169 WICHITA FALLS TX	4.50	0	0	6	1	27.50	2.08	14.75	44.34	10.15	1713	121
170 BILOXI-GULFPORT MS	4.50	0	0	6	1	27.06	2.05	14.51	43.62	10.32	1515	112
171 SPOKANE WA	4.50	0	0	6	1	25.43	1.93	13.64	41.00	10.98	1758	123
172 TACOMA WA	4.50	0	0	6	1	25.07	1.90	13.45	40.42	11.13	1676	119
173 MCALLEN-PHARR-EDINBU	4.50	0	0	6	1	24.43	1.85	13.11	39.39	11.42	1543	113
174 * OHIO	4.50	0	0	6	0	63.15	4.78	33.87	101.80	4.42	7	
175 * MISSOURI	4.50	0	0	6	0	54.53	4.13	29.25	87.92	5.12	7	
176 UTICA-ROME NY	4.50	0	0	6	0	42.59	3.23	22.84	68.65	6.55	2658	145
177 GLENS FALLS NY	4.50	0	0	6	0	35.22	2.67	18.89	56.78	7.93	1723	121
178 SHEBOYGAN WI	4.50	0	0	6	0	31.83	2.41	17.07	51.31	8.77	1776	124
179 BAKERSFIELD CA	4.50	0	0	6	0	30.95	2.35	16.60	49.89	9.02	3500	140
180 EAU CLAIRE WI	4.50	0	0	6	0	29.85	2.26	16.01	48.12	9.35	1665	119
181 WAUSAU WI	4.50	0	0	6	0	29.50	2.23	15.82	47.55	9.46	1586	115
182 OCALA FL	4.50	0	0	6	0	25.65	1.94	13.76	41.36	10.88	1599	116
183 MODESTO CA	4.50	0	0	6	0	25.10	1.90	13.46	40.46	11.12	1511	112
184 NEWPORT NEWS-HAMPTON	3.75	0	0	5	2	47.32	3.59	25.38	76.29	4.92	638	172
185 NEW LONDON-NORWICH C	3.75	0	0	5	2	42.75	3.24	22.93	68.92	5.44	478	162
186 HAMILTON-MIDDLETOWN	3.75	0	0	5	1	40.76	3.09	21.86	65.71	5.71	471	160
187 TERRE HAUTE IN	3.75	0	0	5	1	39.20	2.97	21.02	63.19	5.93	1499	150
188 MUNCIE IN	3.75	0	0	5	1	38.34	2.91	20.57	61.81	6.07	396	142
189 ANDERSON IN	3.75	0	0	5	1	37.30	2.83	20.00	60.12	6.24	453	156
190 MACON GA	3.75	0	0	5	1	36.07	2.73	19.35	58.16	6.45	1400	173
191 BLOOMINGTON IN	3.75	0	0	5	1	35.96	2.72	19.29	57.97	6.47	386	139
192 SAVANNAH GA	3.75	0	0	5	1	34.31	2.60	18.40	55.32	6.78	1368	179
193 FORT SMITH AR-OK	3.75	0	0	5	1	34.06	2.58	18.27	54.92	6.83	3379	142
194 KILLEEN-TEMPLE TX	3.75	0	0	5	1	28.41	2.15	15.24	45.80	8.19	2090	134
195 ALEXANDRIA LA	3.75	0	0	5	1	27.99	2.12	15.01	45.12	8.31	1988	131
196 ST CLOUD MN	3.75	0	0	5	1	26.30	1.99	14.10	42.39	8.85	2175	136
197 FARGO-MOORHEAD ND-MN	3.75	0	0	5	1	26.23	1.99	14.07	42.28	8.87	2794	146
198 PUEBLO CO	3.75	0	0	5	1	23.29	1.76	12.49	37.55	9.99	2405	141
199 FORT COLLINS CO	3.75	0	0	5	1	22.25	1.69	11.93	35.86	10.46	2610	144
200 PROVO-OREM UT	3.75	0	0	5	1	21.62	1.64	11.59	34.85	10.76	2014	132
201 * ILLINOIS	3.75	0	0	5	0	42.79	3.24	22.95	68.98	5.44	6	
202 FALL RIVER MA-RI	3.75	0	0	5	0	33.83	2.56	18.15	54.54	6.88	1975	131
203 FRESNO CA	3.75	0	0	5	0	32.68	2.48	17.53	52.68	7.12	3500	140
204 TEXARKANA TX-AR	3.75	0	0	5	0	27.97	2.12	15.00	45.09	8.32	2000	131
205 ABILENE TX	3.75	0	0	5	0	25.71	1.95	13.79	41.45	9.05	2724	145
206 OXNARD-SIMI VALLEY-V	3.75	0	0	5	0	24.40	1.85	13.09	39.34	9.53	1864	127
207 SANTA ROSA CA	3.75	0	0	5	0	22.40	1.70	12.02	36.12	10.38	1604	116
208 GRAND FORKS ND-MN	3.75	0	0	5	0	22.08	1.67	11.84	35.60	10.53	3451	141
209 GREELEY CO	3.75	0	0	5	0	21.63	1.64	11.60	34.88	10.75	3500	140
210 BILLINGS MT	3.75	0	0	5	0	20.54	1.56	11.02	33.12	11.32	2642	145
211 VALLEJO-FAIRFIELD-NA	3.75	0	0	5	0	20.46	1.55	10.98	32.99	11.37	1611	117
212 BISMARK ND	3.75	0	0	5	0	20.36	1.54	10.92	32.82	11.43	3500	140
213 SALEM OR	3.75	0	0	5	0	19.97	1.51	10.71	32.20	11.65	1902	128
214 CASPER WY	3.75	0	0	5	0	19.83	1.50	10.63	31.96	11.73	3500	140
215 LAS CRUCES NM	3.75	0	0	5	0	19.44	1.47	10.43	31.35	11.96	3500	140
216 LANCASTER PA	3.00	0	0	4	2	48.52	3.68	26.02	78.22	3.84	946	217
217 CHARLESTON WV	3.00	0	0	4	2	48.34	3.66	25.93	77.93	3.85	1255	197
218 ROANOKE VA	3.00	0	0	4	2	42.25	3.20	22.66	68.11	4.40	1187	205
219 ATLANTIC CITY NJ	3.00	0	0	4	1	42.61	3.23	22.85	68.69	4.37	569	181
220 HAGERSTOWN MD	3.00	0	0	4	1	36.41	2.76	19.53	58.69	5.11	459	157

TABLE 3

.995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
221 * MARYLAND	3.00	0	0	4	0	49.25	3.73	26.42	79.40	3.78	5	
222 * MASSACHUSETTS	3.00	0	0	4	0	42.26	3.20	22.67	68.13	4.40	4	
223 * INDIANA	3.00	0	0	4	0	40.74	3.09	21.85	65.69	4.57	5	
224 LYNCHBURG VA	3.00	0	0	4	0	37.83	2.87	20.29	60.98	4.92	1368	179
225 * IOWA	3.00	0	0	4	0	34.58	2.62	18.54	55.74	5.38	4	
226 * MISSISSIPPI	3.00	0	0	4	0	31.91	2.42	17.11	51.44	5.83	5	
227 * WISCONSIN	3.00	0	0	4	0	31.80	2.41	17.06	51.27	5.85	4	
228 * GEORGIA	3.00	0	0	4	0	31.14	2.36	16.70	50.21	5.98	5	
229 * FLORIDA	3.00	0	0	4	0	30.48	2.31	16.35	49.14	6.10	5	
230 * KANSAS	3.00	0	0	4	0	29.54	2.24	15.85	47.63	6.30	5	
231 * ALABAMA	3.00	0	0	4	0	28.87	2.19	15.48	46.54	6.45	4	
232 * LOUISIANA	3.00	0	0	4	0	26.74	2.03	14.34	43.10	6.96	4	
233 * COLORADO	3.00	0	0	4	0	21.88	1.66	11.74	35.28	8.50	4	
234 * ARIZONA	3.00	0	0	4	0	18.82	1.43	10.09	30.34	9.89	3	
235 * UTAH	3.00	0	0	4	0	18.66	1.41	10.01	30.08	9.97	3	
236 * WASHINGTON	3.00	0	0	4	0	17.32	1.31	9.29	27.92	10.75	3	
237 * MONTANA	3.00	0	0	4	0	16.95	1.28	9.09	27.33	10.98	2	
238 FLINT MI	2.25	0	0	3	2	49.74	3.77	26.68	80.18	2.81	1182	206
239 SOUTH BEND IN	2.25	0	0	3	2	48.50	3.67	26.01	78.18	2.88	909	216
240 ANN ARBOR MI	2.25	0	0	3	2	46.30	3.51	24.83	74.64	3.01	711	202
241 KALAMAZOO-PORTAGE MI	2.25	0	0	3	2	45.60	3.46	24.46	73.51	3.06	1165	208
242 ROCKFORD IL	2.25	0	0	3	1	45.50	3.45	24.40	73.35	3.07	802	211
243 SPRINGFIELD IL	2.25	0	0	3	1	41.85	3.17	22.44	67.46	3.34	1190	205
244 WILLIAMSPORT PA	2.25	0	0	3	1	41.35	3.13	22.18	66.66	3.38	1215	202
245 SAGINAW MI	2.25	0	0	3	1	41.09	3.11	22.04	66.24	3.40	814	212
246 CHAMPAIGN-URBANA-RAN	2.25	0	0	3	1	40.79	3.09	21.88	65.75	3.42	1000	217
247 BATTLE CREEK MI	2.25	0	0	3	1	40.16	3.04	21.54	64.75	3.47	1263	196
248 WHEELING WV-OH	2.25	0	0	3	1	39.60	3.00	21.24	63.84	3.52	944	217
249 STATE COLLEGE PA	2.25	0	0	3	1	39.58	3.00	21.23	63.80	3.53	1115	212
250 LAFAYETTE-WEST LAFAY	2.25	0	0	3	1	39.40	2.99	21.13	63.52	3.54	500	167
251 PARKERSBURG-MARIETTA	2.25	0	0	3	1	39.30	2.98	21.08	63.36	3.55	1244	192
252 ELKHART IN	2.25	0	0	3	1	38.87	2.95	20.85	62.67	3.59	468	159
253 JACKSON MI	2.25	0	0	3	1	38.85	2.94	20.84	62.63	3.59	698	200
254 CUMBERLAND MD-WV	2.25	0	0	3	1	38.53	2.92	20.67	62.12	3.62	758	207
255 MUSKEGON-NORTON SHOR	2.25	0	0	3	1	38.24	2.90	20.51	61.65	3.65	1037	216
256 NEWARK OH	2.25	0	0	3	1	38.08	2.89	20.42	61.39	3.67	686	192
257 APPLETON-OSHKOSH WI	2.25	0	0	3	1	37.58	2.85	20.16	60.59	3.71	1404	172
258 KOKOMO IN	2.25	0	0	3	1	36.60	2.77	19.63	59.00	3.81	554	178
259 DECATUR IL	2.25	0	0	3	1	36.32	2.75	19.48	58.56	3.84	578	182
260 BENTON HARBOR MI	2.25	0	0	3	1	35.71	2.71	19.15	57.57	3.91	580	183
261 BAY CITY MI	2.25	0	0	3	1	34.55	2.62	18.53	55.70	4.04	447	155
262 OWENSBORO KY	2.25	0	0	3	1	32.93	2.50	17.66	53.09	4.24	462	158
263 BURLINGTON VT	2.25	0	0	3	0	31.10	2.36	16.68	50.14	4.49	417	147
264 * ARKANSAS	2.25	0	0	3	0	27.15	2.06	14.56	43.78	5.14	4	
265 LEXINGTON-FAYETTE KY	1.50	0	0	2	2	47.94	3.63	25.71	77.28	1.94	1423	280
266 NEWBRGH-MIDDLETOWN N	1.50	0	0	2	2	42.34	3.21	22.71	68.25	2.20	833	213
267 SPRINGFIELD OH	1.50	0	0	2	2	39.14	2.97	20.99	63.10	2.38	834	213
268 CEDAR RAPIDS IA	1.50	0	0	2	1	36.46	2.76	19.56	58.78	2.55	717	203
269 COLUMBUS GA-AL	1.50	0	0	2	1	36.45	2.76	19.55	58.76	2.55	1100	213
270 ASHEVILLE NC	1.50	0	0	2	1	36.27	2.75	19.45	58.47	2.57	1107	212
271 SALISBURY-CONCORD NC	1.50	0	0	2	1	35.94	2.72	19.27	57.93	2.59	1258	197
272 SPRINGFIELD MO	1.50	0	0	2	1	34.90	2.64	18.72	56.26	2.67	1244	179
273 JANESVILLE-BELIOT WI	1.50	0	0	2	1	34.48	2.61	18.50	55.59	2.70	721	203
274 HICKORY NC	1.50	0	0	2	1	33.79	2.56	18.13	54.48	2.75	653	194
275 CLARKSVILLE-HOPKINSV	1.50	0	0	2	1	33.73	2.56	18.09	54.37	2.76	1264	196

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OF POOR QUALITY

TABLE J-5

.995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
276 ANDERSON SC	1.50	0	0	2	1	33.02	2.50	17.71	53.23	2.82	749	206
277 ATHENS GE	1.50	0	0	2	1	32.20	2.45	17.31	52.03	2.88	929	217
278 DUBUQUE IA	1.50	0	0	2	1	32.17	2.44	17.25	51.86	2.89	612	188
279 KANKAKEE IL	1.50	0	0	2	1	31.86	2.41	17.09	51.37	2.92	678	198
280 TALLAHASSEE FL	1.50	0	0	2	1	31.79	2.41	17.05	51.24	2.93	1271	195
281 WATERLOO-CEDAR FALLS	1.50	0	0	2	1	31.62	2.40	16.96	50.97	2.94	568	180
282 FLORENCE AL	1.50	0	0	2	1	31.53	2.39	16.91	50.82	2.95	1258	177
283 FORENCE SC	1.50	0	0	2	1	30.94	2.34	16.59	49.87	3.01	805	211
284 ROCHESTER MN	1.50	0	0	2	1	30.86	2.34	16.55	49.75	3.02	656	195
285 WILMINGTON NC	1.50	0	0	2	1	30.76	2.33	16.50	49.50	3.03	1040	216
286 ANNISTON AL	1.50	0	0	2	1	30.58	2.32	16.40	49.30	3.04	611	180
287 ROCK HILL SC	1.50	0	0	2	1	30.56	2.32	16.39	49.26	3.05	684	199
288 TUSCALOOSA AL	1.50	0	0	2	1	30.49	2.31	16.35	49.15	3.05	1333	185
289 COLUMBIA MO	1.50	0	0	2	1	29.83	2.26	16.00	48.09	3.12	685	199
290 DAYTONA BEACH FL	1.50	0	0	2	1	29.82	2.26	15.99	48.07	3.12	1062	215
291 IOWA CITY IW	1.50	0	0	2	1	29.81	2.26	15.99	48.05	3.12	619	189
292 GADSDEN AL	1.50	0	0	2	1	29.48	2.23	15.81	47.53	3.16	555	178
293 MONROE LA	1.50	0	0	2	1	29.42	2.23	15.78	47.43	3.16	638	192
294 LA CROSSE WI	1.50	0	0	2	1	29.37	2.23	15.75	47.34	3.17	451	155
295 MELBOURNE-TITUSVILLE	1.50	0	0	2	1	29.37	2.23	15.75	47.34	3.17	1011	216
296 JOPLIN MO	1.50	0	0	2	1	29.23	2.21	15.68	47.12	3.18	1271	195
297 LUBBOCK TX	1.50	0	0	2	1	29.22	2.21	15.67	47.10	3.18	893	216
298 WACO TX	1.50	0	0	2	1	29.02	2.20	15.56	46.78	3.21	1000	217
299 ALBANY GA	1.50	0	0	2	1	28.95	2.19	15.53	46.68	3.21	678	198
300 GAINESVILLE FL	1.50	0	0	2	1	28.90	2.19	15.50	46.59	3.22	916	216
301 TYLER TX	1.50	0	0	2	1	28.20	2.14	15.12	45.46	3.30	934	217
302 LONGVIEW TX	1.50	0	0	2	1	28.12	2.13	15.08	45.33	3.31	1175	207
303 ST JOSEPH MO	1.50	0	0	2	1	27.67	2.10	14.84	44.61	3.36	840	213
304 SIOUX CITY NE-IA	1.50	0	0	2	1	27.63	2.09	14.82	44.54	3.37	1126	211
305 LAKE CHARLES LA	1.50	0	0	2	1	27.62	2.09	14.81	44.52	3.37	1105	212
306 PINE BLUFF AR	1.50	0	0	2	1	27.18	2.06	14.58	43.81	3.42	873	215
307 SIOUX FALLS SD	1.50	0	0	2	1	27.14	2.06	14.56	43.75	3.43	813	212
308 PORTSMOUTH-DOVER-ROC	1.50	0	0	2	1	27.07	2.05	14.52	43.64	3.44	496	166
309 LAWTON OK	1.50	0	0	2	1	26.43	2.00	14.17	42.60	3.52	1084	214
310 FORT MYERS FL	1.50	0	0	2	1	26.24	1.99	14.08	42.31	3.55	785	209
311 PASCAGOULA-MOSS POIN	1.50	0	0	2	1	26.20	1.98	14.05	42.23	3.55	736	205
312 FORT WALTON BEACH FL	1.50	0	0	2	1	26.17	1.98	14.04	42.19	3.56	944	217
313 LAWRENCE KS	1.50	0	0	2	1	26.10	1.98	14.00	42.08	3.56	471	160
314 PANAMA CITY FL	1.50	0	0	2	1	25.57	1.94	13.71	41.21	3.64	747	206
315 BRYAN-COLLEGE STATIO	1.50	0	0	2	1	25.08	1.90	13.45	40.43	3.71	585	183
316 ENID OK	1.50	0	0	2	1	24.40	1.85	13.09	39.33	3.81	1054	215
317 SHERMAN-DENISON TX	1.50	0	0	2	1	24.39	1.85	13.08	39.32	3.81	940	217
318 BRADENTON FL	1.50	0	0	2	1	24.30	1.84	13.04	39.18	3.83	739	205
319 STOCKTON CA	1.50	0	0	2	1	23.70	1.80	12.71	38.21	3.93	1412	170
320 ODESSA TX	1.50	0	0	2	1	23.10	1.75	12.39	37.24	4.03	907	216
321 MIDLAND TX	1.50	0	0	2	1	22.90	1.74	12.28	36.93	4.06	939	217
322 BOISE CITY ID	1.50	0	0	2	1	22.37	1.69	12.00	36.06	4.16	1043	216
323 SAN ANGELO TX	1.50	0	0	2	1	22.30	1.69	11.96	35.96	4.17	1500	150
324 BROWNSVILLE-HARLINGE	1.50	0	0	2	1	21.45	1.63	11.50	34.58	4.34	876	216
325 BREMERTON WA	1.50	0	0	2	1	16.85	1.20	9.04	27.17	5.52	393	141
326 * CONNECTICUT	1.50	0	0	2	0	38.37	2.91	20.58	61.86	2.42	4	
327 SANTA BARBARA-SANTA	1.50	0	0	2	0	28.90	2.19	15.50	46.59	3.22	2737	145
328 RENO NV	1.50	0	0	2	0	25.51	1.93	13.68	41.13	3.65	3500	140
329 VISALIA-TULARE-PORTE	1.50	0	0	2	0	25.20	1.91	13.52	40.63	3.69	3500	140
330 BANGOR ME	1.50	0	0	2	0	24.25	1.84	13.01	39.09	3.84	350	129

TABLE J-5

.995 SHARED/UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
331 SALINAS-SEASIDE-MONT	1.50	0	0	2	0	23.89	1.81	12.81	38.51	3.90	3324	143
332 * OREGON	1.50	0	0	2	0	22.45	1.70	12.04	36.19	4.14	4	
333 EUGENE-SPRINGFIELD O	1.50	0	0	2	0	22.21	1.68	11.91	35.80	4.19	3500	140
334 CHICO CA	1.50	0	0	2	0	20.71	1.57	11.11	33.39	4.49	1645	118
335 LAREDO TX	1.50	0	0	2	0	20.57	1.56	11.03	33.16	4.52	3306	143
336 SANTA CRUZ CA	1.50	0	0	2	0	20.32	1.54	10.90	32.76	4.58	440	153
337 YUBA CITY CA	1.50	0	0	2	0	19.73	1.49	10.58	31.81	4.72	1776	124
338 YAKIMA WA	1.50	0	0	2	0	19.23	1.46	10.31	31.00	4.84	3500	140
339 REDDING CA	1.50	0	0	2	0	18.95	1.44	10.16	30.55	4.91	3500	140
340 RICHLAND-KENNEWICK W	1.50	0	0	2	0	18.54	1.40	9.94	29.89	5.02	2975	146
341 MEDFORD OR	1.50	0	0	2	0	18.35	1.39	9.84	29.59	5.07	2812	146
342 GREAT FALLS MT	1.50	0	0	2	0	18.16	1.38	9.74	29.27	5.12	2661	145
343 BELLINGHAM WA	1.50	0	0	2	0	16.79	1.27	9.01	27.07	5.54	2126	135
344 CHARLOTTESVILLE VA	0.75	0	0	1	1	37.16	2.82	19.93	59.91	1.25	1191	205
345 SHARON PA	0.75	0	0	1	1	36.27	2.75	19.45	58.47	1.28	670	197
346 BLOOMINGTON-NORMAL I	0.75	0	0	1	1	34.81	2.64	18.67	56.11	1.34	1173	207
347 JACKSONVILLE NC	0.75	0	0	1	1	30.06	2.28	16.12	48.46	1.55	765	208
348 VICTORIA TX	0.75	0	0	1	1	22.16	1.68	11.89	35.73	2.10	892	216
349 PETERSBURG-COLONIAL	0.75	0	0	1	0	35.07	2.66	18.81	56.54	1.33	808	211
350 DANVILLE VA	0.75	0	0	1	0	32.87	2.49	17.63	52.99	1.42	1018	216
351 * SOUTH CAROLINA	0.75	0	0	1	0	27.87	2.11	14.95	44.93	1.67	5	
352 * NEW MEXICO	0.75	0	0	1	0	19.33	1.46	10.37	31.16	2.41	5	
353 OLYMPIA WA	0.75	0	0	1	0	16.26	1.23	8.72	26.21	2.86	714	202
354 * WEST VIRGINIA	0.00	0	0	0	0	41.18	3.12	22.08	66.38	0.00		
355 * MICHIGAN	0.00	0	0	0	0	40.27	3.05	21.60	64.92	0.00	6	
356 * RHODE ISLAND	0.00	0	0	0	0	37.38	2.83	20.05	60.26	0.00		
357 * DELAWARE	0.00	0	0	0	0	37.35	2.83	20.03	60.22	0.00	1	
358 * NORTH CAROLINA	0.00	0	0	0	0	34.37	2.60	18.43	55.40	0.00	5	
359 * NEW HAMPSHIRE	0.00	0	0	0	0	29.73	2.25	15.94	47.92	0.00		
360 * VERMONT	0.00	0	0	0	0	28.83	2.18	15.46	46.47	0.00		
361 * MAINE	0.00	0	0	0	0	23.28	1.76	12.49	37.53	0.00		
362 * WYOMING	0.00	0	0	0	0	18.38	1.39	9.86	29.64	0.00	1	
363 * NEVADA	0.00	0	0	0	0	17.63	1.34	9.46	28.42	0.00	1	
364 * IDAHO	0.00	0	0	0	0	17.51	1.33	9.39	28.23	0.00	5	
	4871.01	5	350	4918	327	17842.93	1351.95	9570.12	28765.00	16.93		

TABLE J-6

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
1 NEW YORK NY-NJ	562.65	0	136	179	2	431.67	101.32	717.86	1250.85	44.98	1384	237
2 CHICAGO IL	278.40	0	56	136	3	267.64	62.82	445.08	775.54	35.90	3500	140
3 LOS ANGELES-LONG BEA	153.00	0	40	36	3	175.70	41.24	292.17	509.13	30.05	3500	140
4 PHILADELPHIA PA-NJ	145.65	0	36	43	2	154.24	36.20	256.51	446.95	32.59	3500	140
5 DETROIT MI	114.75	0	20	69	3	141.44	33.20	235.22	409.86	28.00	3500	140
6 WASHINGTON DC-MD	110.85	0	19	68	2	132.81	31.17	220.86	384.85	28.80	2812	146
7 BOSTON MA	97.80	0	12	80	1	95.57	22.43	158.93	276.93	35.32	1233	200
8 NASSAU-SUFFOLK NY	82.80	0	12	60	1	85.21	20.00	141.71	246.93	33.53	1218	202
9 CLEVELAND OH	79.20	0	8	72	1	85.68	20.11	142.49	248.27	31.90	1519	112
10 HOUSTON TX	73.95	0	8	65	2	90.87	21.33	151.12	263.32	28.08	3560	140
11 BALTIMORE MD	73.95	0	8	65	2	89.39	20.98	148.65	259.02	28.55	2259	138
12 PITTSBURGH PA	73.20	0	8	64	2	90.13	21.16	149.87	261.17	28.03	3049	146
13 MINNEAPOLIS-ST PAUL	73.20	0	8	64	1	85.64	20.10	142.42	248.16	29.50	3500	140
14 ATLANTA GA	72.60	0	4	80	1	81.13	19.04	134.91	235.08	30.88	3500	140
15 ST LOUIS MO-IL	70.35	0	4	77	1	79.94	18.76	132.95	231.65	30.37	3500	140
16 DALLAS-FORT WORTH TX	69.60	0	4	76	1	78.80	18.50	131.05	228.35	30.48	3500	140
17 MILWAUKEE WI	63.60	0	4	68	1	67.97	15.95	113.03	196.95	32.29	1455	161
18 NEWARK NJ	60.45	0	3	68	1	65.79	15.44	109.41	190.65	31.71	1008	217
19 CINCINNATI OH-KY	43.35	0	4	41	2	67.40	15.82	112.09	195.31	22.20	2149	136
20 * NEW YORK	42.75	0	5	36	0	87.53	20.55	145.57	253.64	16.85	6	
21 SAN FRANCISCO-OAKLAN	42.60	0	4	40	1	64.87	15.23	107.89	187.99	22.66	2480	143
22 BUFFALO NY	42.60	0	4	40	1	50.48	11.85	83.94	146.26	29.13	1590	116
23 JERSEY CITY NJ	39.90	0	11	7	0	28.71	6.74	47.74	83.19	47.96	47	21
24 INDIANAPOLIS IN	39.60	0	4	36	1	59.22	13.90	98.48	171.59	23.08	3072	145
25 COLUMBUS OH	39.60	0	4	36	1	55.72	13.08	92.66	161.45	24.53	2459	142
26 DENVER-BOULDER CO	39.45	0	3	40	1	53.94	12.66	89.70	156.30	25.24	3500	140
27 KANSAS CITY MO-KS	38.70	0	3	39	1	53.27	12.50	88.59	154.37	25.07	3341	143
28 NEW HAVEN-WEST HAVEN	36.45	0	3	36	1	37.70	8.85	62.70	109.26	33.36	337	125
29 LOUISVILLE KY-IN	33.15	0	1	40	1	48.03	11.27	79.87	139.18	23.82	1392	174
30 BRIDGEPORT CT	33.15	0	1	40	0	31.75	7.45	52.80	92.00	36.03	198	120
31 NEW BRUNSWICK-PERTH	33.15	0	1	40	0	31.00	7.28	51.55	89.82	36.91	312	118
32 MIAMI FL	31.20	0	3	29	1	46.56	10.93	77.42	134.91	23.13	2042	133
33 DAYTON OH	31.20	0	3	29	1	42.97	10.08	71.45	124.51	25.06	1707	121
34 CHARLOTTE-GASTONIA N	31.20	0	3	29	1	37.95	8.91	63.11	109.96	28.37	1525	113
35 HARTFORD CT	30.90	0	1	37	1	44.10	10.35	73.34	127.79	24.18	1032	216
36 PROVIDENCE-WARWICK-P	30.75	0	0	41	1	39.32	9.23	65.40	113.95	26.99	747	206
37 ROCHESTER NY	30.45	0	3	28	1	43.83	10.29	72.88	127.00	23.98	2966	146
38 NEW ORLEANS LA	30.45	0	3	28	1	43.44	10.20	72.24	125.88	24.19	1966	130
39 NASHVILLE-DAVIDSON T	30.45	0	3	28	1	42.53	9.98	70.73	123.25	24.71	3500	140
40 MEMPHIS TN-AR	30.45	0	3	28	1	41.15	9.66	68.42	119.23	25.54	2298	139
41 NORTHEAST PENNSYLVAN	30.45	0	3	28	1	40.65	9.54	67.59	117.78	25.85	1951	130
42 RICHMOND VA	30.45	0	3	28	1	40.34	9.47	67.09	116.90	26.05	2145	136
43 HARRISBURG PA	30.45	0	3	28	1	36.56	8.58	60.80	105.94	28.74	1624	117
44 AKRON OH	30.00	0	0	40	1	36.83	8.64	61.25	106.73	28.11	903	216
45 SPRINGFIELD-CHICOPEE	30.00	0	0	40	1	33.70	7.91	56.04	97.65	30.72	633	171
46 ALBANY-SCHENECTADY-T	29.40	0	1	35	1	40.95	9.61	68.10	118.67	24.78	2674	144
47 SAN DIEGO CA	29.40	0	1	35	1	39.90	9.36	66.35	115.60	25.43	3500	140
48 MERIDEN CT	28.20	0	8	4	0	20.86	4.90	34.69	60.45	46.65	24	24
49 TOLEDO OH-MI	27.15	0	1	32	1	38.74	9.09	64.43	112.27	24.18	2187	137
50 BIRMINGHAM AL	27.15	0	1	32	1	38.74	9.09	64.42	112.24	24.19	3358	142
51 OKLAHOMA CITY OK	27.15	0	1	32	1	38.71	9.08	64.37	112.16	24.21	3491	140
52 TAMPA-ST PETERSBURG	27.15	0	1	32	1	37.55	8.81	62.44	108.80	24.95	2045	133
53 WATERBURY CT	27.15	0	1	32	0	24.90	5.84	41.40	72.14	37.63	257	100
54 ALLENTOWN-BETHLEHEM-	26.40	0	1	31	1	36.32	8.52	60.39	105.23	25.09	1490	152
55 GRAND RAPIDS MI	24.90	0	1	29	1	35.29	8.28	58.68	102.25	24.35	1420	169

TABLE J-6

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
56 WILMINGTON DE-NJ	24.00	0	0	32	1	34.45	8.09	57.29	99.82	24.04	1165	208
57 LONG BRANCH-ASBURY P	24.00	0	0	32	0	28.05	6.58	46.64	81.28	29.53	476	161
58 BURLINGTON NC	24.00	0	0	32	0	25.96	6.09	43.18	75.23	31.90	428	150
59 NEW LONDON-NORWICH C	24.00	0	0	32	0	23.92	5.62	39.79	69.32	34.62	478	162
60 HAMILTON-MIDDLETOWN	24.00	0	0	32	0	22.81	5.35	37.93	66.09	36.32	471	140
61 ELMIRA NY	24.00	0	0	32	0	21.48	5.04	35.73	62.25	38.55	415	147
62 BRISTOL CT	21.60	0	4	12	0	20.81	4.88	34.60	60.29	35.82	79	34
63 NORFOLK-VIRGINIA BEA	21.00	0	0	28	1	37.46	8.79	62.29	108.54	19.35	1337	341
64 ANAHEIM-SANTA ANA-GA	21.00	0	0	28	1	28.96	6.80	48.16	83.91	25.03	782	209
65 YOUNGSTOWN-WARREN OH	21.00	0	0	28	1	28.73	6.74	47.77	83.25	25.23	1023	216
66 READING PA	21.00	0	0	28	1	28.45	6.68	47.31	82.44	25.47	862	215
67 GARY-HAMMOND-EAST CH	21.00	0	0	28	1	28.23	6.63	46.95	81.81	25.67	937	217
68 CANTON OH	21.00	0	0	28	1	27.65	6.49	45.98	80.12	26.21	965	217
69 LANCASTER PA	21.00	0	0	28	1	27.15	6.37	45.15	78.67	26.69	946	217
70 SOUTH BEND IN	21.00	0	0	28	1	27.14	6.37	45.13	78.64	26.71	909	216
71 POUGHKEEPSIE NY	21.00	0	0	28	0	27.81	6.53	46.25	80.60	26.06	813	212
72 NEWPORT NEWS-HAMPTON	21.00	0	0	28	0	26.48	6.22	44.04	76.74	27.37	638	192
73 ERIE PA	21.00	0	0	28	0	26.44	6.21	43.97	76.61	27.41	813	212
74 ANN ARBOR MI	21.00	0	0	28	0	25.82	6.06	42.94	74.81	28.07	711	202
75 WORCESTER MA	21.00	0	0	28	0	25.11	5.89	41.76	72.76	28.86	550	178
76 ATLANTIC CITY NJ	21.00	0	0	28	0	23.84	5.60	39.65	69.09	30.40	569	181
77 LORAIN-ELYRIA OH	21.00	0	0	28	0	23.10	5.42	38.42	66.94	31.37	495	166
78 LAFAYETTE-WEST LAFAY	21.00	0	0	28	0	22.05	5.17	36.66	63.88	32.87	500	167
79 VINELAND-MILLVILLE-B	21.00	0	0	28	0	22.04	5.17	36.66	63.88	32.88	500	167
80 MANSFIELD OH	21.00	0	0	28	0	21.91	5.14	36.43	63.49	33.08	496	166
81 ELKHART IN	21.00	0	0	28	0	21.75	5.11	36.17	63.03	33.32	468	157
82 NEW BRITAIN CT	18.60	0	4	8	0	22.02	5.17	36.62	63.82	29.15	119	50
83 NORWALK CT	18.60	0	4	8	0	17.27	4.05	28.73	50.05	37.16	88	38
84 PATERSON-CLIFTON-PAS	18.45	0	3	12	1	24.37	5.72	40.53	70.62	26.13	192	78
85 * PENNSYLVANIA	18.00	0	0	24	0	48.64	11.42	80.89	140.94	12.77	7	
86 STAMFORD CT	15.60	0	4	4	0	20.45	4.80	34.00	59.25	26.33	121	51
87 PHOENIX AZ	15.15	0	1	16	1	36.75	8.63	61.11	106.48	14.23	3500	140
88 GREENSBORO-WINSTON-S	15.15	0	1	16	1	36.03	8.46	59.92	104.41	14.51	3213	144
89 SYRACUSE NY	15.15	0	1	16	1	34.38	8.07	57.17	99.61	15.21	2419	142
90 LANSING-EAST LANSING	15.15	0	1	16	1	34.32	8.05	57.07	99.44	15.24	2277	139
91 SEATTLE-EVERETT WA	15.15	0	1	16	1	33.77	7.93	56.15	97.84	15.48	3500	140
92 FORT WAYNE IN	15.15	0	1	16	1	31.41	7.37	52.23	91.01	16.65	1750	122
93 RALEIGH-DURHAM NC	15.15	0	1	16	1	31.11	7.30	51.73	90.15	16.81	1553	114
94 OMAHA NE-IA	15.15	0	1	16	1	30.73	7.21	51.11	89.06	17.01	1537	113
95 KNOXVILLE TN	15.15	0	1	16	1	29.76	6.98	49.49	86.23	17.57	1630	117
96 TRENTON NJ	15.15	0	1	16	1	24.16	5.67	40.18	70.02	21.64	228	90
97 PITTSFIELD MA	15.15	0	1	16	0	21.06	4.94	35.03	61.04	24.82	213	85
98 NEW BEDFORD MA	15.15	0	1	16	0	20.77	4.88	34.54	60.19	25.17	206	83
99 LOWELL MA-NH	15.15	0	1	16	0	20.27	4.76	33.70	58.73	25.80	179	73
100 TULSA OK	14.40	0	1	15	1	33.53	7.87	55.75	97.15	14.82	3500	140
101 JACKSONVILLE FL	14.40	0	1	15	1	31.12	7.30	51.76	90.18	15.97	3199	144
102 SAN ANTONIO TX	14.40	0	1	15	1	30.88	7.25	51.36	89.49	16.09	2527	143
103 PEORIA IL	14.40	0	1	15	1	27.33	6.41	45.45	79.20	18.18	1803	125
104 * NEW JERSEY	13.80	0	2	10	0	29.23	6.86	48.61	84.70	16.29	3	
105 * OHIO	13.50	0	0	10	0	35.33	8.29	58.76	102.37	13.18	7	
106 PORTLAND OR-WA	12.90	0	1	13	1	28.72	6.74	47.75	83.21	15.50	3500	140
107 GREENVILLE-SPARTANBU	12.90	0	1	13	1	28.35	6.66	47.15	82.16	15.70	2115	135
108 CHATTANOOGA TN-GA	12.90	0	1	13	1	27.75	6.51	46.15	80.41	16.04	2109	135
109 BINGHAMTON NY-PA	12.90	0	1	13	1	25.84	6.06	42.97	74.87	17.23	2071	134
110 JOHNSTOWN PA	12.90	0	1	13	1	25.24	5.92	41.97	73.12	17.64	1770	123

TABLE J-6

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
111 DAVENPORT-ROCK ISLAN	12.90	0	1	13	1	24.93	5.85	41.45	72.23	17.86	1704	121
112 BATON ROUGE LA	12.90	0	1	13	1	24.42	5.73	40.61	70.75	18.23	1617	117
113 HUNTINGTON-ASHLAND W	12.90	0	1	13	1	24.31	5.71	40.43	70.45	18.31	1756	123
114 LIMA OH	12.90	0	1	13	1	24.10	5.66	40.08	69.84	18.47	1705	121
115 MANCHESTER NH	12.90	0	1	13	1	21.13	4.96	35.13	61.21	21.07	258	101
116 SACRAMENTO CA	12.75	0	0	17	1	26.95	6.32	44.81	78.08	16.33	3434	141
117 NASHUA NH	12.45	0	3	4	0	18.60	4.36	30.92	53.88	23.11	154	64
118 BROCKTON MA	12.45	0	3	4	0	18.08	4.24	30.07	52.40	23.76	137	57
119 SAN JOSE CA	12.00	0	0	16	1	28.88	6.78	48.03	83.69	14.34	1300	191
120 YORK PA	12.00	0	0	16	1	28.71	6.74	47.74	83.18	14.43	1435	165
121 COLUMBIA SC	12.00	0	0	16	1	28.66	6.73	47.67	83.06	14.45	1465	158
122 JOHNSON CITY-KINGSPO	12.00	0	0	16	1	27.49	6.45	45.71	79.65	15.07	2866	146
123 SALT LAKE CITY-OGDEN	12.00	0	0	16	1	26.36	6.19	43.84	76.38	15.71	3500	140
124 LITTLE ROCK-NORTH LI	12.00	0	0	16	1	25.82	6.06	42.94	74.82	16.04	1489	153
125 AUSTIN TX	12.00	0	0	16	1	25.68	6.03	42.71	74.42	16.13	2766	145
126 WICHITA KS	12.00	0	0	16	1	24.99	5.87	41.56	72.41	16.57	2448	142
127 ORLANDO FL	12.00	0	0	16	1	24.85	5.83	41.32	72.00	16.67	2528	143
128 EVANSVILLE IN-KY	12.00	0	0	16	1	24.26	5.69	40.34	70.29	17.07	1975	131
129 TERRE HAUTE IN	12.00	0	0	16	1	21.88	5.14	36.39	63.40	18.93	1499	150
130 MUNCIE IN	12.00	0	0	16	1	21.46	5.04	35.68	62.17	19.30	396	142
131 LAWRENCE-HAVERHILL M	12.00	0	0	16	1	21.29	5.00	35.41	61.70	19.45	305	116
132 BLOOMINGTON IN	12.00	0	0	16	1	20.10	4.72	33.43	58.25	20.60	386	139
133 * VIRGINIA	12.00	0	0	16	0	31.28	7.34	52.02	90.64	13.24	5	
134 PORTLAND ME	12.00	0	0	16	0	19.07	4.48	31.72	55.27	21.71	367	134
135 RACINE WI	12.00	0	0	16	0	18.85	4.43	31.35	54.63	21.96	337	125
136 DANBURY CT	12.00	0	0	16	0	17.72	4.16	29.46	51.33	23.38	255	100
137 KENOSHA WI	12.00	0	0	16	0	17.23	4.04	28.65	49.92	24.04	272	105
138 LAFAYETTE LA	12.00	0	0	16	0	15.82	3.71	26.31	45.85	26.17	283	109
139 * MARYLAND	11.25	0	0	15	0	27.56	6.47	45.83	79.86	14.09	5	
140 * KENTUCKY	10.50	0	0	14	0	26.57	6.24	44.19	77.00	13.64	4	
141 FITCHBURG-LEOMINSTER	9.15	0	1	8	0	17.55	4.12	29.18	50.85	17.99	167	69
142 MADISON WI	9.00	0	0	12	1	28.26	6.63	46.99	81.88	10.99	1198	204
143 FLINT MI	9.00	0	0	12	1	27.83	6.53	46.28	80.65	11.16	1182	206
144 DES MOINES IA	9.00	0	0	12	1	27.50	6.45	45.73	79.68	11.29	1136	210
145 CHARLESTON WV	9.00	0	0	12	1	27.05	6.35	44.98	78.38	11.48	1255	197
146 LEXINGTON-FAYETTE KY	9.00	0	0	12	1	26.82	6.30	44.61	77.73	11.58	1493	280
147 KALAMAZOO-PORTAGE MI	9.00	0	0	12	1	25.52	5.99	42.43	73.94	12.17	1165	208
148 ROCKFORD IL	9.00	0	0	12	1	25.46	5.98	42.34	73.78	12.20	802	211
149 FORT LAUDERDALE-HOLL	9.00	0	0	12	1	25.35	5.95	42.16	73.46	12.25	1219	202
150 NEWBRGH-MIDDLETOWN N	9.00	0	0	12	1	23.69	5.56	39.40	68.65	13.11	833	213
151 ROANOKE VA	9.00	0	0	12	1	23.60	5.54	39.25	68.39	13.16	1187	205
152 SPRINGFIELD IL	9.00	0	0	12	1	23.42	5.50	38.94	67.85	13.26	1190	205
153 WILLIAMSPORT PA	9.00	0	0	12	1	23.10	5.42	38.42	66.95	13.44	1215	202
154 CHAMPAIGN-URBANA-RAN	9.00	0	0	12	1	22.82	5.36	37.95	66.13	13.61	1000	217
155 SAGINAW MI	9.00	0	0	12	1	22.67	5.32	37.70	65.69	13.70	814	212
156 BATTLE CREEK MI	9.00	0	0	12	1	22.44	5.27	37.32	65.02	13.84	1263	196
157 STEUBENVILLE-WEIRTON	9.00	0	0	12	1	22.23	5.22	36.97	64.43	13.97	582	183
158 WHEELING WV-OH	9.00	0	0	12	1	22.16	5.20	36.85	64.21	14.02	944	217
159 STATE COLLEGE PA	9.00	0	0	12	1	22.15	5.20	36.83	64.18	14.02	1115	212
160 ALTOONA PA	9.00	0	0	12	1	22.14	5.20	36.82	64.16	14.03	530	173
161 FAYETTEVILLE NC	9.00	0	0	12	1	22.08	5.18	36.71	63.97	14.07	654	194
162 PARKERSBURG-MARIETTA	9.00	0	0	12	1	21.94	5.15	36.49	63.59	14.15	1244	199
163 SPRINGFIELD OH	9.00	0	0	12	1	21.90	5.14	36.42	63.46	14.18	834	213
164 JACKSON MI	9.00	0	0	12	1	21.68	5.09	36.05	62.82	14.33	698	200
165 CUMBERLAND MD-WV	9.00	0	0	12	1	21.56	5.06	35.86	62.48	14.40	758	207

TABLE J-

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
166 MUSKEGON-NORTON SHOR	9.00	0	0	12	1	21.40	5.02	35.59	62.01	14.51	1037	216
167 NEWARK OH	9.00	0	0	12	1	21.31	5.00	35.44	61.75	14.58	686	199
168 LYNCHBURG VA	9.00	0	0	12	1	21.17	4.97	35.20	61.33	14.67	1368	179
169 APPLETON-OSHKOSH WI	9.00	0	0	12	1	20.87	4.90	34.71	60.40	14.88	1404	172
170 ANDERSON IN	9.00	0	0	12	1	20.87	4.90	34.71	60.47	14.88	453	156
171 CHARLOTTESVILLE VA	9.00	0	0	12	1	20.79	4.88	34.50	60.25	14.94	1191	205
172 KOKOMO IN	9.00	0	0	12	1	20.48	4.81	34.06	57.34	15.17	554	178
173 COLUMBUS GA-AL	9.00	0	0	12	1	20.40	4.79	33.92	57.10	15.23	1100	213
174 CEDAR RAPIDS IA	9.00	0	0	12	1	20.36	4.78	33.86	59.00	15.25	717	203
175 HAGERSTOWN MD	9.00	0	0	12	1	20.35	4.70	33.84	58.96	15.27	459	157
176 ASHEVILLE NC	9.00	0	0	12	1	20.30	4.76	33.75	58.81	15.30	1107	212
177 SHARON PA	9.00	0	0	12	1	20.27	4.76	33.71	58.74	15.32	670	197
178 DECATUR IL	9.00	0	0	12	1	20.22	4.75	33.63	58.60	15.36	578	182
179 SALISBURY-CONCORD NC	9.00	0	0	12	1	20.04	4.70	33.32	58.07	15.50	1258	197
180 BENTON HARBOR MI	9.00	0	0	12	1	19.98	4.69	33.23	57.91	15.54	580	183
181 GREEN BAY WI	9.00	0	0	12	1	19.59	4.60	32.59	56.78	15.85	524	172
182 BAY CITY MI	9.00	0	0	12	1	19.33	4.54	32.15	56.02	16.06	447	155
183 JANESVILLE-BELIOT WI	9.00	0	0	12	1	19.30	4.53	32.09	55.92	16.10	721	203
184 OWENSBORO KY	9.00	0	0	12	1	18.43	4.33	30.65	53.40	16.85	462	158
185 * MISSOURI	9.00	0	0	12	0	30.45	7.15	50.64	88.24	10.20	7	
186 * TENNESSEE	9.00	0	0	12	0	25.80	6.06	42.90	74.75	12.04	4	
187 * MASSACHUSETTS	9.00	0	0	12	0	23.65	5.55	39.33	68.53	13.13	4	
188 * INDIANA	9.00	0	0	12	0	22.80	5.35	37.92	66.07	13.62	5	
189 * CONNECTICUT	9.00	0	0	12	0	21.47	5.04	35.71	62.22	14.46	4	
190 * CALIFORNIA	9.00	0	0	12	0	21.09	4.95	35.08	61.13	14.72	5	
191 HICKORY NC	9.00	0	0	12	0	18.87	4.43	31.38	54.68	16.46	653	194
192 DUBUQUE IA	9.00	0	0	12	0	18.00	4.23	29.94	52.16	17.25	612	188
193 WATERLOO-CEDAR FALLS	9.00	0	0	12	0	17.61	4.13	29.28	51.02	17.64	568	180
194 BURLINGTON VT	9.00	0	0	12	0	17.40	4.09	28.94	50.43	17.85	417	147
195 LA CROSSE WI	9.00	0	0	12	0	16.43	3.86	27.33	47.62	18.90	451	155
196 PETERSBURG-COLONIAL	8.25	0	0	11	1	19.62	4.61	32.64	56.87	14.51	808	211
197 LINCOLN NE	8.25	0	0	11	1	19.60	4.60	32.60	56.80	14.52	845	214
198 BLOOMINGTON-NORMAL I	8.25	0	0	11	1	19.44	4.56	32.33	56.34	14.64	1173	207
199 ANDERSON SC	8.25	0	0	11	1	18.48	4.34	30.72	53.54	15.41	749	206
200 KANKAKEE IL	8.25	0	0	11	0	17.83	4.18	29.65	51.66	15.97	678	198
201 FORENCE SC	8.25	0	0	11	0	17.31	4.06	28.79	50.16	16.45	805	211
202 ROCHESTER MN	8.25	0	0	11	0	17.27	4.05	28.72	50.04	16.49	656	195
203 ROCK HILL SC	8.25	0	0	11	0	17.10	4.01	28.43	49.54	16.65	684	199
204 ANNISTON AL	8.25	0	0	11	0	17.08	4.01	28.41	49.51	16.66	611	188
205 COLUMBIA MO	8.25	0	0	11	0	16.67	3.91	27.72	48.31	17.08	685	179
206 IOWA CITY IW	8.25	0	0	11	0	16.62	3.90	27.63	48.15	17.14	619	187
207 GADSDEN AL	8.25	0	0	11	0	16.50	3.87	27.44	47.81	17.26	555	178
208 MONROE LA	8.25	0	0	11	0	16.46	3.86	27.38	47.71	17.29	638	192
209 PORTSMOUTH-DOVER-ROC	8.25	0	0	11	0	15.15	3.56	25.19	43.87	18.79	496	166
210 LAWRENCE KS	8.25	0	0	11	0	14.61	3.43	24.27	42.32	19.49	471	160
211 JACKSON MS	6.90	0	1	5	1	23.45	5.50	39.00	67.95	10.15	1651	118
212 AUGUSTA GA-SC	6.75	0	0	9	1	23.08	5.42	38.39	66.89	10.09	1700	120
213 CHARLESTON-NORTH CHA	6.00	0	0	8	1	23.94	5.62	39.81	69.37	8.65	2618	144
214 UTICA-ROME NY	6.00	0	0	8	1	23.83	5.59	39.63	69.05	8.69	2658	145
215 HUNTSVILLE AL	6.00	0	0	8	1	23.51	5.52	39.10	68.13	8.81	1919	129
216 RIVERSIDE-SAN BERNAR	6.00	0	0	8	1	21.94	5.15	36.49	63.58	9.44	3500	140
217 SHREVEPORT LA	6.00	0	0	8	1	21.87	5.13	36.37	63.38	9.47	2363	141
218 MOBILE AL	6.00	0	0	8	1	21.74	5.10	36.16	63.01	9.52	2818	146
219 MONTGOMERY AL	6.00	0	0	8	1	21.22	4.98	35.30	61.50	9.76	2013	132
220 LAS VEGAS NV	6.00	0	0	8	1	20.64	4.84	34.32	59.80	10.03	3500	140

ORIGINAL PAGE IS OF POOR QUALITY

TABLE J-6

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
221 DULUTH-SUPERIOR MN-W	6.00	0	0	8	1	20.28	4.76	33.73	58.76	10.21	3500	140
222 WEST PALM BEACH-BOCA	6.00	0	0	8	1	20.07	4.71	33.37	58.14	10.32	2023	132
223 GLENS FALLS NY	6.00	0	0	8	1	19.71	4.63	32.77	57.11	10.51	1723	121
224 TOPEKA KS	6.00	0	0	8	1	18.95	4.45	31.51	54.91	10.93	1764	123
225 FALL RIVER MA-RI	6.00	0	0	8	1	18.93	4.44	31.48	54.86	10.94	1975	131
226 PENSACOLA FL	6.00	0	0	8	1	18.49	4.34	30.74	53.57	11.20	1697	120
227 SHEBOYGAN WI	6.00	0	0	8	1	17.81	4.18	29.62	51.61	11.63	1776	124
228 * TEXAS	6.00	0	0	8	0	20.33	4.77	33.82	58.92	10.18	4	
229 WAUSAU WI	6.00	0	0	8	0	16.51	3.87	27.45	47.83	12.54	1586	115
230 CORPUS CHRISTI TX	6.00	0	0	8	0	16.40	3.85	27.28	47.53	12.62	1526	113
231 LEWISTON-AUBURN ME	6.00	0	0	8	0	15.33	3.60	25.49	44.42	13.51	102	96
232 * NEBRASKA	6.00	0	0	8	0	15.19	3.56	25.26	44.01	13.63	2	
233 * OKLAHOMA	6.00	0	0	8	0	14.25	3.35	23.70	41.30	14.53	3	
234 * MINNESOTA	4.50	0	0	6	0	25.01	5.87	41.59	72.46	6.21	7	
235 * ILLINOIS	4.50	0	0	6	0	23.77	5.58	39.53	68.89	6.53	6	
236 * MICHIGAN	4.50	0	0	6	0	22.50	5.28	37.42	65.21	6.90	6	
237 * SOUTH DAKOTA	4.50	0	0	6	0	11.53	2.71	19.18	33.42	13.46	2	
238 * NORTH DAKOTA	4.50	0	0	6	0	11.18	2.62	18.59	32.40	13.89	2	
239 * ARIZONA	4.50	0	0	6	0	10.53	2.47	17.51	30.52	14.75	3	
240 * UTAH	4.50	0	0	6	0	10.43	2.45	17.34	30.21	14.90	3	
241 MACON GA	3.00	0	0	4	1	20.12	4.72	33.46	58.31	5.15	1400	173
242 ALBUQUERQUE NM	3.00	0	0	4	1	19.64	4.61	32.65	56.90	5.27	3500	140
243 SPRINGFIELD MO	3.00	0	0	4	1	19.53	4.58	32.47	56.59	5.30	1244	199
244 SAVANNAH GA	3.00	0	0	4	1	19.20	4.51	31.93	55.64	5.39	1368	179
245 FORT SMITH AR-OK	3.00	0	0	4	1	19.02	4.46	31.63	55.12	5.44	3379	142
246 CLARKSVILLE-HOPKINSV	3.00	0	0	4	1	18.87	4.43	31.39	54.69	5.49	1264	196
247 BEAUMONT-PORT ARTHUR	3.00	0	0	4	1	18.67	4.38	31.05	54.10	5.55	2207	137
248 FRESNO CA	3.00	0	0	4	1	18.29	4.29	30.41	52.99	5.66	3500	140
249 TUCSON AZ	3.00	0	0	4	1	18.22	4.28	30.29	52.78	5.68	3500	140
250 BAKERSFIELD CA	3.00	0	0	4	1	17.32	4.06	28.80	50.18	5.98	3500	140
251 FAYETTEVILLE-SPRINGD	3.00	0	0	4	1	17.18	4.03	28.58	49.79	6.03	1809	125
252 COLORADO SPRINGS CO	3.00	0	0	4	1	16.96	3.98	28.21	49.15	6.10	2710	145
253 EAU CLAIRE WI	3.00	0	0	4	1	16.70	3.92	27.78	48.40	6.20	1665	119
254 SANTA BARBARA-SANTA	3.00	0	0	4	1	16.17	3.80	26.89	46.86	6.40	2737	145
255 LAKELAND-WINTER HAVE	3.00	0	0	4	1	16.14	3.79	26.85	46.78	6.41	1858	127
256 AMARILLO TX	3.00	0	0	4	1	15.48	3.63	25.74	44.86	6.69	1812	125
257 WICHITA FALLS TX	3.00	0	0	4	1	15.32	3.60	25.48	44.40	6.76	1713	121
258 BILOXI-GULFPORT MS	3.00	0	0	4	1	15.14	3.55	25.18	43.88	6.84	1515	112
259 GALVESTON-TEXAS CITY	3.00	0	0	4	1	14.10	3.31	23.44	40.84	7.34	399	142
260 BANGOR ME	3.00	0	0	4	1	13.57	3.18	22.57	39.32	7.63	350	129
261 * IOWA	3.00	0	0	4	0	19.35	4.54	32.17	56.06	5.35	4	
262 * NORTH CAROLINA	3.00	0	0	4	0	19.21	4.51	31.94	55.66	5.39	5	
263 * MISSISSIPPI	3.00	0	0	4	0	17.86	4.19	29.69	51.74	5.80	5	
264 * WISCONSIN	3.00	0	0	4	0	17.80	4.18	29.60	51.57	5.82	4	
265 * GEORGIA	3.00	0	0	4	0	17.41	4.09	28.95	50.44	5.95	5	
266 * FLORIDA	3.00	0	0	4	0	17.03	4.00	28.32	49.34	6.08	5	
267 * KANSAS	3.00	0	0	4	0	16.53	3.88	27.49	47.90	6.26	5	
268 * ALABAMA	3.00	0	0	4	0	16.11	3.78	26.79	46.69	6.43	4	
269 KILLEEN-TEMPLE TX	3.00	0	0	4	0	15.90	3.73	26.44	46.06	6.51	2090	134
270 ALEXANDRIA LA	3.00	0	0	4	0	15.66	3.68	26.04	45.38	6.61	1988	131
271 TEXARKANA TX-AR	3.00	0	0	4	0	15.65	3.67	26.03	45.35	6.62	2000	131
272 * SOUTH CAROLINA	3.00	0	0	4	0	15.57	3.65	25.89	45.11	6.65	5	
273 * ARKANSAS	3.00	0	0	4	0	15.18	3.56	25.25	43.99	6.82	4	
274 * LOUISIANA	3.00	0	0	4	0	14.96	3.51	24.88	43.35	6.92	4	
275 ST CLOUD MN	3.00	0	0	4	0	14.71	3.45	24.47	42.64	7.04	2175	136

TABLE J-6

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
276 FARGO-MOORHEAD ND-MN	3.00	0	0	4	0	14.68	3.44	24.41	42.53	7.05	2794	146
277 ABILENE TX	3.00	0	0	4	0	14.39	3.38	23.92	41.69	7.20	2724	145
278 OCALA FL	3.00	0	0	4	0	14.34	3.36	23.84	41.54	7.22	1599	116
279 RENO NV	3.00	0	0	4	0	14.28	3.35	23.74	41.37	7.25	3500	140
280 SPOKANE WA	3.00	0	0	4	0	14.23	3.34	23.66	41.24	7.28	1758	123
281 VISALIA-TULARE-PORTZ	3.00	0	0	4	0	14.10	3.31	23.45	40.86	7.34	3500	140
282 MODESTO CA	3.00	0	0	4	0	14.04	3.30	23.35	40.69	7.37	1511	112
283 TACOMA WA	3.00	0	0	4	0	14.03	3.29	23.33	40.65	7.38	1676	119
284 MCALLEN-PHARR-EDINBU	3.00	0	0	4	0	13.67	3.21	22.74	39.62	7.57	1543	113
285 OXNARD-SIMI VALLEY-V	3.00	0	0	4	0	13.66	3.21	22.71	39.57	7.58	1864	127
286 SANTA ROSA CA	3.00	0	0	4	0	12.54	2.94	20.85	36.33	8.26	1604	116
287 CHICO CA	3.00	0	0	4	0	11.59	2.72	19.27	33.58	8.93	1645	118
288 VALLEJO-FAIRFIELD-NA	3.00	0	0	4	0	11.45	2.69	19.04	33.18	9.04	1611	117
289 DANVILLE VA	2.25	0	0	3	1	18.39	4.32	30.59	53.30	4.22	1018	216
290 ATHENS GE	2.25	0	0	3	1	17.96	4.22	29.87	52.05	4.32	929	217
291 TALLAHASSEE FL	2.25	0	0	3	1	17.79	4.17	29.58	51.54	4.37	1271	195
292 FLORENCE AL	2.25	0	0	3	1	17.64	4.14	29.34	51.12	4.40	1258	197
293 EL PASO TX	2.25	0	0	3	1	17.45	4.09	29.01	50.55	4.45	1057	215
294 WILMINGTON NC	2.25	0	0	3	1	17.16	4.03	28.54	49.72	4.53	1040	216
295 TUSCALOOSA AL	2.25	0	0	3	1	17.02	3.99	28.30	49.31	4.56	1333	185
296 JACKSONVILLE NC	2.25	0	0	3	1	16.73	3.93	27.82	48.48	4.64	765	208
297 DAYTONA BEACH FL	2.25	0	0	3	1	16.68	3.92	27.75	48.35	4.65	1062	215
298 MELBOURNE-TITUSVILLE	2.25	0	0	3	1	16.43	3.86	27.33	47.62	4.73	1011	216
299 JOPLIN MO	2.25	0	0	3	1	16.36	3.84	27.20	47.40	4.75	1271	195
300 LUBBOCK TX	2.25	0	0	3	1	16.35	3.84	27.19	47.37	4.75	893	216
301 WACO TX	2.25	0	0	3	1	16.24	3.81	27.00	47.05	4.78	1000	217
302 ALBANY GA	2.25	0	0	3	1	16.20	3.80	26.94	46.95	4.79	678	198
303 GAINESVILLE FL	2.25	0	0	3	1	16.06	3.77	26.71	46.53	4.84	916	216
304 TYLER TX	2.25	0	0	3	1	15.78	3.70	26.24	45.72	4.92	934	217
305 LONGVIEW TX	2.25	0	0	3	1	15.71	3.69	26.13	45.53	4.94	1175	207
306 ST JOSEPH MO	2.25	0	0	3	1	15.48	3.63	25.75	44.87	5.01	840	213
307 SIOUX CITY NE-IA	2.25	0	0	3	1	15.46	3.63	25.71	44.79	5.02	1126	211
308 LAKE CHARLES LA	2.25	0	0	3	1	15.45	3.63	25.70	44.78	5.02	1105	212
309 SARASOTA FL	2.25	0	0	3	1	15.18	3.56	25.24	43.99	5.12	587	184
310 SIOUX FALLS SD	2.25	0	0	3	1	15.16	3.56	25.21	43.94	5.12	813	212
311 PASCAGOULA-MOSS POIN	2.25	0	0	3	1	14.66	3.44	24.38	42.48	5.30	736	205
312 BRYAN-COLLEGE STATIO	2.25	0	0	3	1	14.03	3.29	23.34	40.66	5.53	585	183
313 SALINAS-SEASIDE-MONT	2.25	0	0	3	0	13.37	3.14	22.23	38.73	5.81	3324	143
314 STOCKTON CA	2.25	0	0	3	0	13.26	3.11	22.05	38.43	5.86	1412	170
315 PUEBLO CO	2.25	0	0	3	0	13.03	3.06	21.67	37.77	5.96	2405	141
316 SAN ANGELO TX	2.25	0	0	3	0	12.48	2.93	20.76	36.17	6.22	1500	150
317 FORT COLLINS CO	2.25	0	0	3	0	12.45	2.92	20.70	36.07	6.24	2610	144
318 EUGENE-SPRINGFIELD O	2.25	0	0	3	0	12.43	2.92	20.67	36.01	6.25	3500	140
319 GRAND FORKS ND-MN	2.25	0	0	3	0	12.36	2.90	20.55	35.81	6.28	3451	141
320 GREELEY CO	2.25	0	0	3	0	12.11	2.84	20.13	35.08	6.41	3500	140
321 PROVO-OREM UT	2.25	0	0	3	0	12.10	2.84	20.12	35.05	6.42	2014	132
322 LAREDO TX	2.25	0	0	3	0	11.51	2.70	19.14	33.36	6.75	3306	143
323 BILLINGS MT	2.25	0	0	3	0	11.48	2.69	19.09	33.26	6.76	2642	145
324 BISMARK ND	2.25	0	0	3	0	11.39	2.67	18.94	33.01	6.82	3500	140
325 SANTA CRUZ CA	2.25	0	0	3	0	11.37	2.67	18.91	32.95	6.83	440	153
326 SALEM OR	2.25	0	0	3	0	11.18	2.62	18.59	32.39	6.95	1902	128
327 CASPER WY	2.25	0	0	3	0	11.09	2.60	18.45	32.15	7.00	3500	140
328 YUBA CITY CA	2.25	0	0	3	0	11.04	2.59	18.36	31.99	7.03	1776	124
329 LAS CRUCES NM	2.25	0	0	3	0	10.88	2.55	18.09	31.53	7.14	3500	140
330 YAKIMA WA	2.25	0	0	3	0	10.76	2.53	17.89	31.18	7.22	3500	140

TABLE J-6

.999 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
331 REDDING CA	2.25	0	0	3	0	10.60	2.49	17.64	30.73	7.32	3500	140
332 RICHLAND-KENNEWICK W	2.25	0	0	3	0	10.37	2.43	17.25	30.06	7.49	2975	146
333 * WASHINGTON	1.50	0	0	2	0	9.69	2.27	16.11	28.08	5.34	3	
334 * MONTANA	1.50	0	0	2	0	9.49	2.23	15.78	27.49	5.46	2	
335 PINE BLUFF AR	0.75	0	0	1	1	15.21	3.57	25.29	44.07	1.70	873	215
336 LAWTON OK	0.75	0	0	1	1	14.79	3.47	24.59	42.85	1.75	1084	214
337 FORT WALTON BEACH FL	0.75	0	0	1	1	14.65	3.44	24.36	42.44	1.77	944	217
338 FORT MYERS FL	0.75	0	0	1	1	14.64	3.44	24.35	42.43	1.77	785	209
339 PANAMA CITY FL	0.75	0	0	1	1	14.31	3.36	23.79	41.45	1.81	747	206
340 ENID OK	0.75	0	0	1	1	13.65	3.20	22.70	39.56	1.90	1054	215
341 SHERMAN-DENISON TX	0.75	0	0	1	1	13.65	3.20	22.70	39.55	1.90	940	217
342 BRADENTON FL	0.75	0	0	1	1	13.60	3.19	22.62	39.41	1.90	739	205
343 ODESSA TX	0.75	0	0	1	1	12.92	3.03	21.49	37.45	2.00	907	216
344 MIDLAND TX	0.75	0	0	1	1	12.82	3.01	21.31	37.14	2.02	939	217
345 BOISE CITY ID	0.75	0	0	1	1	12.52	2.94	20.82	36.27	2.07	1043	216
346 VICTORIA TX	0.75	0	0	1	0	12.40	2.91	20.63	35.94	2.09	872	216
347 BROWNSVILLE-HARLINGE	0.75	0	0	1	0	12.00	2.82	19.96	34.78	2.16	896	216
348 MEDFORD OR	0.75	0	0	1	0	10.27	2.41	17.08	29.76	2.52	2812	146
349 GREAT FALLS MT	0.75	0	0	1	0	10.16	2.38	16.90	29.44	2.55	2661	145
350 BREMERTON WA	0.75	0	0	1	0	9.43	2.21	15.68	27.33	2.74	393	141
351 BELLINGHAM WA	0.75	0	0	1	0	9.40	2.21	15.63	27.23	2.75	2126	135
352 * WEST VIRGINIA	0.00	0	0	0	0	23.04	5.41	38.32	66.76	0.00		
353 * RHODE ISLAND	0.00	0	0	0	0	20.92	4.91	34.79	60.61	0.00		
354 * DELAWARE	0.00	0	0	0	0	20.90	4.91	34.76	60.57	0.00	1	
355 * NEW HAMPSHIRE	0.00	0	0	0	0	16.63	3.90	27.66	48.20	0.00		
356 * VERMONT	0.00	0	0	0	0	16.11	3.78	26.80	46.70	0.00		
357 * MAINE	0.00	0	0	0	0	13.03	3.06	21.66	37.74	0.00		
358 * OREGON	0.00	0	0	0	0	12.56	2.95	20.89	36.40	0.00	4	
359 * COLORADO	0.00	0	0	0	0	12.24	2.87	20.36	35.48	0.00	4	
360 * NEW MEXICO	0.00	0	0	0	0	10.82	2.54	17.99	31.34	0.00	5	
361 * WYOMING	0.00	0	0	0	0	10.29	2.41	17.11	29.81	0.00	1	
362 * NEVADA	0.00	0	0	0	0	9.87	2.32	16.41	28.59	0.00	1	
363 * IDAHO	0.00	0	0	0	0	9.80	2.30	16.29	28.39	0.00	5	
364 OLYMPIA WA	0.00	0	0	0	0	9.10	2.14	15.13	26.37	0.00	714	202
	5875.81	0	542	5558	230	9977.53	2341.87	16592.60	28912.00	20.32		

TABLE J-7

.995 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
1 NEW YORK NY-NJ	406.60	0	124	128	2	389.99	90.97	645.10	1126.16	43.21	1384	237
2 CHICAGO IL	232.80	0	52	92	3	241.80	56.42	400.02	698.24	33.34	3500	140
3 LOS ANGELES-LONG BEA	146.40	0	36	44	2	158.74	37.04	262.60	458.37	31.94	3500	140
4 PHILADELPHIA PA-NJ	114.00	0	20	68	3	139.35	32.51	230.54	402.40	28.33	3500	140
5 DETROIT MI	104.05	0	19	60	2	127.78	29.82	211.40	369.00	28.41	3500	140
6 WASHINGTON DC-MD	101.55	0	17	64	2	119.99	28.00	198.50	346.49	29.31	2812	146
7 BOSTON MA	83.55	0	12	61	1	86.34	20.15	142.84	249.33	33.51	1233	200
8 CLEVELAND OH	76.20	0	8	68	1	77.41	18.06	128.07	223.54	34.09	1519	112
9 HOUSTON TX	73.20	0	8	64	1	82.10	19.16	135.82	237.08	30.88	3500	140
10 BALTIMORE MD	73.20	0	8	64	1	80.76	18.84	133.60	233.20	31.39	2259	138
11 PITTSBURGH PA	69.60	0	4	76	1	81.43	19.00	134.71	235.14	29.60	3049	146
12 MINNEAPOLIS-ST PAUL	69.60	0	4	76	1	77.37	18.05	128.00	223.42	31.15	3500	140
13 NASSAU-SUFFOLK NY	62.70	0	3	71	1	76.99	17.96	127.36	222.31	28.20	1218	202
14 NEWARK NJ	57.15	0	1	72	1	59.44	13.87	98.33	171.64	33.30	1008	217
15 ATLANTA GA	44.85	0	4	43	2	73.29	17.10	121.25	211.65	21.19	3500	140
16 ST LOUIS MO-IL	44.85	0	4	43	2	72.22	16.85	119.49	208.56	21.50	3500	140
17 DALLAS-FORT WORTH TX	44.85	0	4	43	2	71.20	16.61	117.78	205.59	21.82	3500	140
18 CINCINNATI OH-KY	42.60	0	4	40	1	60.89	14.21	100.74	175.84	24.23	2149	136
19 SAN FRANCISCO-OAKLAN	39.60	0	4	36	1	58.61	13.68	96.96	169.25	23.40	2480	143
20 MILWAUKEE WI	38.70	0	3	39	1	61.40	14.33	101.58	177.31	21.83	1455	161
21 INDIANAPOLIS IN	38.70	0	3	39	1	53.50	12.48	88.50	154.49	25.05	3072	145
22 * NEW YORK	37.65	0	1	46	0	79.08	18.45	130.83	228.36	16.49	6	
23 COLUMBUS OH	37.20	0	3	37	1	50.34	11.74	83.27	145.36	25.59	2437	142
24 JERSEY CITY NJ	34.35	0	9	8	0	25.94	6.05	42.91	74.90	45.86	47	21
25 BUFFALO NY	33.60	0	4	28	1	45.60	10.64	75.44	131.68	25.52	1590	116
26 LOUISVILLE KY-IN	33.15	0	1	40	1	43.39	10.12	71.79	125.30	26.46	1392	174
27 NEW HAVEN-WEST HAVEN	33.15	0	1	40	0	34.06	7.95	56.35	98.37	33.70	337	125
28 DENVER-BOULDER CO	31.20	0	3	29	1	48.73	11.37	80.62	140.72	22.17	3500	140
29 KANSAS CITY MO-KS	31.20	0	3	29	1	48.13	11.23	79.62	138.98	22.45	3341	143
30 MIAMI FL	30.45	0	3	28	1	42.06	9.81	69.58	121.46	25.07	2042	133
31 NEW ORLEANS LA	30.45	0	3	28	1	39.25	9.16	64.93	113.33	26.87	1966	130
32 DAYTON OH	30.45	0	3	28	1	38.82	9.06	64.22	112.09	27.16	1707	121
33 HARTFORD CT	30.00	0	0	40	1	39.84	9.30	65.91	115.05	26.07	1032	216
34 PROVIDENCE-WARWICK-P	30.00	0	0	40	1	35.53	8.29	58.77	102.59	29.24	747	206
35 ROCHESTER NY	27.15	0	1	32	1	39.59	9.24	65.50	114.34	23.75	2966	146
36 NASHVILLE-DAVIDSON T	27.15	0	1	32	1	38.43	8.97	63.57	110.96	24.47	3500	140
37 MEMPHIS TN-AR	27.15	0	1	32	1	37.17	8.67	61.50	107.34	25.29	2298	139
38 ALBANY-SCHENECTADY-T	27.15	0	1	32	1	37.00	8.63	61.21	106.84	25.41	2624	144
39 NORTHEAST PENNSYLVAN	27.15	0	1	32	1	36.72	8.57	60.75	106.04	25.60	1951	130
40 RICHMOND VA	27.15	0	1	32	1	36.45	8.50	60.29	105.24	25.80	2145	136
41 ALLENTOWN-BETHLEHEM-	26.40	0	1	31	1	32.81	7.66	54.28	94.74	27.87	1490	152
42 BRIDGEPORT CT	26.40	0	1	31	0	28.68	6.69	47.45	82.83	31.87	198	120
43 NEW BRUNSWICK-PERTH	26.40	0	1	31	0	28.01	6.53	46.33	80.87	32.65	312	118
44 MERIDEN CT	25.20	0	8	0	0	18.85	4.40	31.18	54.43	46.30	24	24
45 AKRON OH	24.00	0	0	32	1	33.28	7.76	55.05	96.09	24.98	903	216
46 GRAND RAPIDS MI	24.00	0	0	32	1	31.88	7.44	52.74	92.06	26.07	1420	169
47 WILMINGTON DE-NJ	24.00	0	0	32	1	31.12	7.26	51.49	89.87	26.70	1165	208
48 SPRINGFIELD-CHICOPEE	24.00	0	0	32	1	30.45	7.10	50.37	87.92	27.30	633	191
49 LONG BRANCH-ASBURY P	24.00	0	0	32	0	25.34	5.91	41.92	73.17	32.80	476	161
50 BURLINGTON NC	24.00	0	0	32	0	23.46	5.47	38.80	67.73	35.43	428	150
51 NORFOLK-VIRGINIA BEA	21.00	0	0	28	1	33.84	7.90	55.98	97.72	21.49	1337	341
52 ANAHEIM-SANTA ANA-GA	21.00	0	0	28	0	26.16	6.10	43.28	75.55	27.80	702	209
53 NEW LONDON-NORWICH C	21.00	0	0	28	0	21.61	5.04	35.76	62.41	33.65	478	162
54 BRISTOL CT	20.85	0	4	11	0	18.80	4.39	31.10	54.28	38.41	79	34
55 CHARLOTTE-GASTONIA N	18.45	0	3	12	1	34.28	8.00	56.72	99.00	18.64	1525	113

TABLE J-7

.995 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
56 * PENNSYLVANIA	18.00	0	0	24	0	43.94	10.25	72.70	126.89	14.19	7	
57 NEW BRITAIN CT	15.60	0	4	4	0	19.90	4.64	32.92	57.45	27.15	119	50
58 NORWALK CT	15.60	0	4	4	0	15.61	3.64	25.82	45.06	34.62	80	38
59 SAN DIEGO CA	15.15	0	1	16	1	36.04	8.41	59.63	104.08	14.56	3500	140
60 TOLEDO OH-MI	15.15	0	1	16	1	35.00	8.17	57.91	101.08	14.99	2187	137
61 BIRMINGHAM AL	15.15	0	1	16	1	35.00	8.17	57.89	101.06	14.99	3358	142
62 OKLAHOMA CITY OK	15.15	0	1	16	1	34.97	8.16	57.85	100.98	15.00	3491	140
63 TAMPA-ST PETERSBURG	15.15	0	1	16	1	33.92	7.91	56.12	97.95	15.47	2045	133
64 HARRISBURG PA	15.15	0	1	16	1	33.03	7.71	54.65	95.38	15.88	1624	117
65 RALEIGH-DURHAM NC	15.15	0	1	16	1	28.11	6.56	46.50	81.16	18.67	1553	114
66 OMAHA NE-IA	15.15	0	1	16	1	27.77	6.48	45.94	80.18	18.89	1537	113
67 PATERSON-CLIFTON-PAS	15.15	0	1	16	0	22.02	5.14	36.43	63.58	23.83	192	78
68 PHOENIX AZ	14.40	0	1	15	1	33.20	7.75	54.92	95.87	15.02	3500	140
69 GREENSBORO-WINSTON-S	14.40	0	1	15	1	32.55	7.60	53.86	94.01	15.32	3213	144
70 SYRACUSE NY	14.40	0	1	15	1	31.06	7.25	51.38	89.68	16.06	2419	142
71 LANSING-EAST LANSING	14.40	0	1	15	1	31.00	7.23	51.29	89.53	16.08	2277	139
72 SEATTLE-EVERETT WA	14.40	0	1	15	1	30.51	7.12	50.47	88.09	16.35	3500	140
73 TULSA OK	14.40	0	1	15	1	30.29	7.07	50.11	87.46	16.46	3500	140
74 FORT WAYNE IN	14.40	0	1	15	1	28.37	6.62	46.94	81.93	17.58	1750	122
75 KNOXVILLE TN	14.40	0	1	15	1	26.89	6.27	44.48	77.64	18.55	1630	117
76 WATERBURY CT	14.40	0	1	15	1	22.49	5.25	37.21	64.95	22.17	257	100
77 TRENTON NJ	14.40	0	1	15	1	21.83	5.09	36.11	63.04	22.84	228	90
78 PITTSFIELD MA	14.40	0	1	15	0	19.03	4.44	31.48	54.95	26.20	213	85
79 NEW BEDFORD MA	14.40	0	1	15	0	18.77	4.38	31.04	54.19	26.57	206	83
80 STAMFORD CT	13.20	0	3	5	0	18.47	4.31	30.56	53.34	24.75	121	51
81 JACKSONVILLE FL	12.90	0	1	13	1	28.12	6.56	46.52	81.19	15.89	3199	144
82 SAN ANTONIO TX	12.90	0	1	13	1	27.90	6.51	46.16	80.57	16.01	2527	143
83 PEORIA IL	12.90	0	1	13	1	24.69	5.76	40.85	71.30	18.09	1803	125
84 GREENVILLE-SPARTANBU	12.75	0	0	17	1	25.62	5.98	42.38	73.97	17.24	2115	135
85 MANCHESTER NH	12.75	0	0	17	0	19.09	4.45	31.57	55.11	23.13	258	101
86 PORTLAND OR-WA	12.00	0	0	16	1	25.94	6.05	42.92	74.91	16.02	3500	140
87 YORK PA	12.00	0	0	16	1	25.93	6.05	42.91	74.89	16.02	1435	165
88 COLUMBIA SC	12.00	0	0	16	1	25.90	6.04	42.84	74.78	16.05	1465	158
89 CHATTANOOGA TN-GA	12.00	0	0	16	1	25.07	5.85	41.47	72.39	16.58	2109	135
90 JOHNSON CITY-KINGSPO	12.00	0	0	16	1	24.83	5.79	41.08	71.71	16.73	2866	146
91 LITTLE ROCK-NORTH LI	12.00	0	0	16	1	23.33	5.44	38.59	67.36	17.81	1489	153
92 * OHIO	12.00	0	0	16	0	31.92	7.45	52.81	92.18	13.02	7	
93 * VIRGINIA	12.00	0	0	16	0	28.26	6.59	46.75	81.60	14.71	5	
94 * NEW JERSEY	12.00	0	0	16	0	26.41	6.16	43.69	76.25	15.74	3	
95 LAWRENCE-HAVERHILL M	12.00	0	0	16	0	19.24	4.49	31.82	55.55	21.60	305	116
96 BROCKTON MA	11.40	0	1	11	0	16.34	3.81	27.03	47.18	24.16	137	57
97 LOWELL MA-NH	9.15	0	1	8	1	18.31	4.27	30.29	52.80	17.30	179	73
98 NASHUA NH	9.15	0	1	8	0	16.80	3.92	27.79	48.51	18.86	154	64
99 SAN JOSE CA	9.00	0	0	12	1	26.09	6.09	43.16	75.34	11.95	1300	191
100 YOUNGSTOWN-WARREN OH	9.00	0	0	12	1	25.95	6.06	42.94	74.95	12.01	1023	216
101 READING PA	9.00	0	0	12	1	25.70	6.00	42.52	74.23	12.13	862	215
102 MADISON WI	9.00	0	0	12	1	25.53	5.96	42.23	73.72	12.21	1198	204
103 GARY-HAMMOND-EAST CH	9.00	0	0	12	1	25.51	5.95	42.20	73.65	12.22	937	217
104 FLINT MI	9.00	0	0	12	1	25.14	5.87	41.60	72.61	12.40	1182	206
105 POUGHKEEPSIE NY	9.00	0	0	12	1	25.13	5.86	41.57	72.56	12.40	813	212
106 CANTON OH	9.00	0	0	12	1	24.98	5.83	41.33	72.13	12.48	965	217
107 DES MOINES IA	9.00	0	0	12	1	24.84	5.80	41.10	71.74	12.55	1136	210
108 LANCASTER PA	9.00	0	0	12	1	24.53	5.72	40.58	70.83	12.71	946	217
109 SOUTH BEND IN	9.00	0	0	12	1	24.52	5.72	40.56	70.80	12.71	909	216
110 CHARLESTON WV	9.00	0	0	12	1	24.44	5.70	40.43	70.57	12.75	1255	197

TABLE J-7

.995 UNSHARED

		CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
111	NEWPORT NEWS-HAMPTON	9.00	0	0	12	1	23.92	5.58	39.58	69.09	13.03	638	192
112	ERIE PA	9.00	0	0	12	1	23.89	5.57	39.52	68.98	13.05	813	212
113	ANN ARBOR MI	9.00	0	0	12	1	23.33	5.44	38.59	67.36	13.36	711	202
114	KALAMAZOO-PORTAGE MI	9.00	0	0	12	1	23.05	5.38	38.14	66.57	13.52	1165	208
115	ROCKFORD IL	9.00	0	0	12	1	23.00	5.37	38.05	66.42	13.55	802	211
116	FORT LAUDERDALE-HOLL	9.00	0	0	12	1	22.90	5.34	37.89	66.14	13.61	1219	202
117	WORCESTER MA	9.00	0	0	12	1	22.69	5.29	37.53	65.51	13.74	558	178
118	ATLANTIC CITY NJ	9.00	0	0	12	1	21.54	5.03	35.64	62.20	14.47	569	181
119	NEWBRGH-MIDDLETOWN N	9.00	0	0	12	1	21.40	4.99	35.41	61.81	14.56	833	213
120	ROANOKE VA	9.00	0	0	12	1	21.32	4.98	35.28	61.57	14.62	1187	205
121	SPRINGFIELD IL	9.00	0	0	12	1	21.16	4.94	35.00	61.09	14.73	1190	205
122	WILLIAMSPORT PA	9.00	0	0	12	1	20.87	4.87	34.53	60.28	14.93	1215	202
123	LORAIN-ELYRIA OH	9.00	0	0	12	1	20.87	4.87	34.53	60.27	14.93	495	166
124	CHAMPAIGN-URBANA-RAN	9.00	0	0	12	1	20.62	4.81	34.11	59.54	15.12	1000	217
125	HAMILTON-MIDDLETOWN	9.00	0	0	12	1	20.60	4.81	34.09	59.50	15.13	471	160
126	SAGINAW MI	9.00	0	0	12	1	20.48	4.78	33.88	59.14	15.22	814	212
127	BATTLE CREEK MI	9.00	0	0	12	1	20.27	4.73	33.54	58.54	15.37	1263	196
128	STEUBENVILLE-WEIRTON	9.00	0	0	12	1	20.09	4.69	33.23	58.01	15.52	582	183
129	ALTOONA PA	9.00	0	0	12	1	20.00	4.67	33.09	57.76	15.58	530	173
130	FAYETTEVILLE NC	9.00	0	0	12	1	19.95	4.65	33.00	57.60	15.63	654	194
131	LAFAYETTE-WEST LAFAY	9.00	0	0	12	1	19.92	4.65	32.95	57.52	15.65	500	167
132	VINELAND-MILLVILLE-B	9.00	0	0	12	1	19.92	4.65	32.95	57.51	15.65	500	167
133	PARKERSBURG-MARIETTA	9.00	0	0	12	1	19.83	4.63	32.80	57.25	15.72	1244	199
134	MANSFIELD OH	9.00	0	0	12	1	19.79	4.62	32.75	57.16	15.75	496	166
135	ELKHART IN	9.00	0	0	12	1	19.65	4.59	32.51	56.75	15.86	468	159
136	JACKSON MI	9.00	0	0	12	1	19.59	4.57	32.40	56.56	15.91	698	200
137	ELMIRA NY	9.00	0	0	12	1	19.41	4.53	32.11	56.05	16.06	415	147
138	MUNCIE IN	9.00	0	0	12	1	19.38	4.52	32.07	55.97	16.08	376	142
139	NEWARK OH	9.00	0	0	12	1	19.25	4.49	31.85	55.59	16.19	686	199
140	ANDERSON IN	9.00	0	0	12	1	18.85	4.40	31.19	54.44	16.53	453	156
141	KOKOMO IN	9.00	0	0	12	1	18.50	4.32	30.61	53.43	16.84	554	178
142	HAGERSTOWN MD	9.00	0	0	12	1	18.38	4.29	30.41	53.08	16.96	459	157
143	BLOOMINGTON IN	9.00	0	0	12	1	18.16	4.24	30.04	52.44	17.16	386	139
144	* MARYLAND	9.00	0	0	12	0	24.90	5.81	41.19	71.90	12.52	5	
145	* KENTUCKY	9.00	0	0	12	0	24.01	5.60	39.72	69.33	12.98	4	
146	* TENNESSEE	9.00	0	0	12	0	23.31	5.44	38.56	67.30	13.37	4	
147	* MASSACHUSETTS	9.00	0	0	12	0	21.37	4.99	35.35	61.70	14.59	4	
148	DECATUR IL	9.00	0	0	12	0	18.27	4.26	30.22	52.75	17.06	578	182
149	BENTON HARBOR MI	9.00	0	0	12	0	18.05	4.21	29.87	52.13	17.26	580	183
150	GREEN BAY WI	9.00	0	0	12	0	17.70	4.13	29.29	51.12	17.61	524	172
151	BAY CITY MI	9.00	0	0	12	0	17.47	4.08	28.90	50.44	17.84	447	155
152	PORTLAND ME	9.00	0	0	12	0	17.23	4.02	28.51	49.76	18.09	367	134
153	RACINE WI	9.00	0	0	12	0	17.03	3.97	28.18	49.19	18.30	337	125
154	OWENSBORO KY	9.00	0	0	12	0	16.65	3.88	27.54	48.08	18.72	462	158
155	BURLINGTON VT	9.00	0	0	12	0	15.72	3.67	26.01	45.41	19.82	417	147
156	LA CROSSE WI	9.00	0	0	12	0	14.85	3.46	24.56	42.87	20.99	451	155
157	FITCHBURG-LEOMINSTER	8.40	0	1	7	0	15.85	3.70	26.23	45.78	18.35	167	69
158	LEXINGTON-FAYETTE KY	8.25	0	0	11	1	24.23	5.65	40.09	69.98	11.79	1493	280
159	WHEELING WV-OH	8.25	0	0	11	1	20.02	4.67	33.12	57.81	14.27	944	217
160	STATE COLLEGE PA	8.25	0	0	11	1	20.01	4.67	33.10	57.78	14.28	1115	212
161	SPRINGFIELD OH	8.25	0	0	11	1	19.79	4.62	32.73	57.14	14.44	834	213
162	CUMBERLAND MD-WV	8.25	0	0	11	1	19.48	4.55	32.23	56.25	14.67	758	207
163	MUSKEGON-NORTON SHOR	8.25	0	0	11	1	19.33	4.51	31.98	55.83	14.78	1037	216
164	CEDAR RAPIDS IA	8.25	0	0	11	1	18.40	4.29	30.43	53.12	15.53	717	203
165	SHARON PA	8.25	0	0	11	1	18.31	4.27	30.30	52.89	15.60	670	197

TABLE J-7

.995 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
166 PETERSBURG-COLONIAL	8.25	0	0	11	0	17.73	4.14	29.33	51.20	16.11	808	211
167 LINCOLN NE	8.25	0	0	11	0	17.71	4.13	29.30	51.14	16.13	845	214
168 JANESVILLE-BELIOT WI	8.25	0	0	11	0	17.43	4.07	28.84	50.34	16.39	721	203
169 HICKORY NC	8.25	0	0	11	0	17.05	3.98	28.20	49.23	16.76	653	194
170 DUBUQUE IA	8.25	0	0	11	0	16.26	3.79	26.91	46.76	17.57	612	188
171 WATERLOO-CEDAR FALLS	8.25	0	0	11	0	15.91	3.71	26.32	45.93	17.96	568	180
172 SACRAMENTO CA	6.00	0	0	8	1	24.35	5.68	40.28	70.30	8.53	3434	141
173 SALT LAKE CITY-OGDEN	6.00	0	0	8	1	23.81	5.56	39.40	68.77	8.73	3500	140
174 BINGHAMTON NY-PA	6.00	0	0	8	1	23.34	5.45	38.62	67.41	8.90	2071	134
175 AUSTIN TX	6.00	0	0	8	1	23.20	5.41	38.38	67.00	8.96	2766	145
176 JOHNSTOWN PA	6.00	0	0	8	1	22.80	5.32	37.72	65.84	9.11	1770	123
177 WICHITA KS	6.00	0	0	8	1	22.58	5.27	37.35	65.19	9.20	2448	142
178 DAVENPORT-ROCK ISLAN	6.00	0	0	8	1	22.52	5.25	37.26	65.03	9.23	1704	121
179 ORLANDO FL	6.00	0	0	8	1	22.45	5.24	37.13	64.82	9.26	2528	143
180 BATON ROUGE LA	6.00	0	0	8	1	22.06	5.15	36.49	63.70	9.42	1617	117
181 HUNTINGTON-ASHLAND W	6.00	0	0	8	1	21.96	5.12	36.34	63.42	9.46	1756	123
182 EVANSVILLE IN-KY	6.00	0	0	8	1	21.91	5.11	36.25	63.28	9.48	1975	131
183 LIMA OH	6.00	0	0	8	1	21.77	5.08	36.02	62.87	9.54	1705	121
184 CHARLESTON-NORTH CHA	6.00	0	0	8	1	21.63	5.05	35.78	62.45	9.61	2618	144
185 UTICA-ROME NY	6.00	0	0	8	1	21.53	5.02	35.62	62.17	9.65	2658	145
186 HUNTSVILLE AL	6.00	0	0	8	1	21.24	4.76	35.14	61.34	9.78	1719	129
187 JACKSON MS	6.00	0	0	8	1	21.19	4.94	35.05	61.18	9.81	1651	118
188 AUGUSTA GA-SC	6.00	0	0	8	1	20.85	4.67	34.50	60.22	9.96	1700	120
189 MONTGOMERY AL	6.00	0	0	8	1	19.18	4.47	31.72	55.37	10.84	2013	132
190 GLENS FALLS NY	6.00	0	0	8	1	17.81	4.15	29.46	51.42	11.67	1723	121
191 DANBURY CT	6.00	0	0	8	1	16.00	3.73	26.48	46.22	12.98	255	100
192 * INDIANA	6.00	0	0	8	0	20.60	4.81	34.08	59.49	10.09	5	
193 KENOSHA WI	6.00	0	0	8	0	15.56	3.63	25.75	44.95	13.35	272	105
194 LEWISTON-AUBURN ME	6.00	0	0	8	0	13.85	3.23	22.91	39.99	15.00	102	96
195 * NEBRASKA	5.25	0	0	7	0	13.72	3.20	22.70	39.62	13.25	2	
196 * MISSOURI	4.50	0	0	6	0	27.51	6.42	45.51	79.44	5.66	7	
197 * MINNESOTA	4.50	0	0	6	0	22.59	5.27	37.37	65.24	6.90	7	
198 * OKLAHOMA	4.50	0	0	6	0	12.88	3.00	21.30	37.17	12.10	3	
199 * SOUTH DAKOTA	4.50	0	0	6	0	10.42	2.43	17.24	30.09	14.95	2	
200 * ILLINOIS	3.75	0	0	5	0	21.48	5.01	35.53	62.02	6.05	6	
201 RIVERSIDE-SAN BERNAR	3.00	0	0	4	1	19.82	4.63	32.79	57.24	5.24	3500	140
202 TERRE HAUTE IN	3.00	0	0	4	1	19.77	4.61	32.70	57.08	5.26	1499	150
203 SHREVEPORT LA	3.00	0	0	4	1	19.76	4.61	32.69	57.06	5.26	2363	141
204 MOBILE AL	3.00	0	0	4	1	19.64	4.58	32.50	56.73	5.29	2818	146
205 LYNCHBURG VA	3.00	0	0	4	1	19.12	4.46	31.64	55.22	5.43	1368	179
206 APPLETON-OSHKOSH WI	3.00	0	0	4	1	18.86	4.40	31.20	54.45	5.51	1404	172
207 LAS VEGAS NV	3.00	0	0	4	1	18.65	4.35	30.85	53.84	5.57	3500	140
208 DULUTH-SUPERIOR MN-W	3.00	0	0	4	1	18.32	4.27	30.31	52.91	5.67	3500	140
209 MACON GA	3.00	0	0	4	1	18.18	4.24	30.07	52.49	5.72	1400	173
210 WEST PALM BEACH-BOCA	3.00	0	0	4	1	18.13	4.23	29.99	52.35	5.73	2023	132
211 ALBUQUERQUE NM	3.00	0	0	4	1	17.74	4.14	29.35	51.23	5.86	2500	140
212 SAVANNAH GA	3.00	0	0	4	1	17.35	4.05	28.70	50.09	5.99	1368	179
213 FORT SMITH AR-OK	3.00	0	0	4	1	17.18	4.01	28.43	49.62	6.05	2379	142
214 TOPEKA KS	3.00	0	0	4	1	17.12	3.99	28.32	49.43	6.07	1764	123
215 FALL RIVER MA-RI	3.00	0	0	4	1	17.10	3.99	28.30	49.39	6.07	1975	131
216 BEAUMONT-PORT ARTHUR	3.00	0	0	4	1	16.87	3.94	27.90	48.71	6.16	2207	137
217 PENSACOLA FL	3.00	0	0	4	1	16.70	3.90	27.63	48.23	6.22	1697	120
218 FRESNO CA	3.00	0	0	4	1	16.52	3.85	27.33	47.70	6.29	3500	140
219 SHEBOYGAN WI	3.00	0	0	4	1	16.09	3.75	26.62	46.46	6.46	1776	124
220 FAYETTEVILLE-SPRINGD	3.00	0	0	4	1	15.52	3.62	25.68	44.83	6.69	1809	125

ORIGINAL PAGE IS OF POOR QUALITY

TABLE J-7

.995 UNSHARED

		CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
221	COLORADO SPRINGS CO	3.00	0	0	4	1	15.32	3.58	25.35	44.25	6.78	2710	145
222	EAU CLAIRE WI	3.00	0	0	4	1	15.09	3.52	24.96	43.58	6.88	1665	117
223	LAFAYETTE LA	3.00	0	0	4	1	14.30	3.34	23.65	41.28	7.27	283	109
224	* CONNECTICUT	3.00	0	0	4	0	19.40	4.53	32.09	56.02	5.36	4	
225	* CALIFORNIA	3.00	0	0	4	0	19.06	4.45	31.53	55.03	5.45	5	
226	* TEXAS	3.00	0	0	4	0	18.37	4.29	30.39	53.05	5.66	4	
227	* IOWA	3.00	0	0	4	0	17.48	4.08	28.92	50.47	5.94	4	
228	* NORTH CAROLINA	3.00	0	0	4	0	17.35	4.05	28.71	50.11	5.99	5	
229	TUCSON AZ	3.00	0	0	4	0	16.46	3.84	27.22	47.52	6.31	3500	140
230	* MISSISSIPPI	3.00	0	0	4	0	16.13	3.76	26.69	46.58	6.44	5	
231	* WISCONSIN	3.00	0	0	4	0	16.08	3.75	26.60	46.43	6.46	4	
232	* GEORGIA	3.00	0	0	4	0	15.73	3.67	26.02	45.41	6.61	5	
233	BAKERSFIELD CA	3.00	0	0	4	0	15.65	3.65	25.88	45.18	6.64	3500	140
234	* FLORIDA	3.00	0	0	4	0	15.38	3.59	25.45	44.42	6.75	5	
235	* KANSAS	3.00	0	0	4	0	14.94	3.48	24.71	43.13	6.96	5	
236	WAUSAU WI	3.00	0	0	4	0	14.91	3.48	24.67	43.06	6.97	1586	115
237	CORPUS CHRISTI TX	3.00	0	0	4	0	14.82	3.46	24.52	42.80	7.01	1526	113
238	SANTA BARBARA-SANTA	3.00	0	0	4	0	14.61	3.41	24.17	42.19	7.11	2737	145
239	LAKELAND-WINTER HAVE	3.00	0	0	4	0	14.58	3.40	24.13	42.11	7.12	1858	127
240	* ALABAMA	3.00	0	0	4	0	14.56	3.40	24.08	42.03	7.14	4	
241	KILLEEN-TEMPLE TX	3.00	0	0	4	0	14.36	3.35	23.76	41.47	7.23	2090	134
242	ALEXANDRIA LA	3.00	0	0	4	0	14.15	3.30	23.41	40.86	7.34	1988	131
243	TEXARKANA TX-AR	3.00	0	0	4	0	14.14	3.30	23.39	40.83	7.35	2000	131
244	AMARILLO TX	3.00	0	0	4	0	13.99	3.26	23.14	40.39	7.43	1812	125
245	WICHITA FALLS TX	3.00	0	0	4	0	13.84	3.23	22.90	39.98	7.50	1713	121
246	BILOXI-GULFPORT MS	3.00	0	0	4	0	13.68	3.19	22.63	39.50	7.59	1515	112
247	ST CLOUD MN	3.00	0	0	4	0	13.29	3.10	21.99	38.39	7.82	2175	136
248	OCALA FL	3.00	0	0	4	0	12.95	3.02	21.43	37.40	8.02	1599	116
249	SPOKANE WA	3.00	0	0	4	0	12.86	3.00	21.27	37.12	8.08	1758	123
250	MODESTO CA	3.00	0	0	4	0	12.69	2.96	20.99	36.64	8.19	1511	112
251	TACOMA WA	3.00	0	0	4	0	12.67	2.96	20.97	36.60	8.20	1676	119
252	MCALLEN-PHARR-EDINBU	3.00	0	0	4	0	12.35	2.88	20.44	35.67	8.41	1543	113
253	OXNARD-SIMI VALLEY-V	3.00	0	0	4	0	12.34	2.88	20.41	35.63	8.42	1064	127
254	BANGOR ME	3.00	0	0	4	0	12.26	2.86	20.28	35.40	8.47	350	129
255	SANTA ROSA CA	3.00	0	0	4	0	11.33	2.64	18.74	32.70	9.17	1604	116
256	* NORTH DAKOTA	3.00	0	0	4	0	10.10	2.36	16.71	29.17	10.29	2	
257	CHARLOTTESVILLE VA	2.25	0	0	3	1	18.79	4.38	31.08	54.25	4.15	1191	205
258	COLUMBUS GA-AL	2.25	0	0	3	1	18.43	4.30	30.49	53.21	4.23	1100	213
259	ASHEVILLE NC	2.25	0	0	3	1	18.34	4.28	30.34	52.95	4.25	1107	212
260	SALISBURY-CONCORD NC	2.25	0	0	3	1	18.10	4.22	29.95	52.28	4.30	1258	197
261	SPRINGFIELD MO	2.25	0	0	3	1	17.64	4.12	29.19	50.94	4.42	1244	199
262	BLOOMINGTON-NORMAL I	2.25	0	0	3	1	17.56	4.10	29.06	50.72	4.44	1173	207
263	CLARKSVILLE-HOPKINSV	2.25	0	0	3	1	17.05	3.98	28.21	49.24	4.57	1264	176
264	ANDERSON SC	2.25	0	0	3	1	16.69	3.89	27.61	48.20	4.67	749	206
265	DANVILLE VA	2.25	0	0	3	1	16.62	3.88	27.49	47.98	4.69	1018	216
266	ATHENS GE	2.25	0	0	3	1	16.23	3.79	26.85	46.86	4.80	929	217
267	KANKAKEE IL	2.25	0	0	3	1	16.11	3.76	26.65	46.51	4.84	678	198
268	TALLAHASSEE FL	2.25	0	0	3	1	16.07	3.75	26.58	46.40	4.85	1271	195
269	FLORENCE AL	2.25	0	0	3	1	15.94	3.72	26.37	46.02	4.89	1258	197
270	EL PASO TX	2.25	0	0	3	1	15.76	3.68	26.07	45.51	4.94	1057	215
271	FORENCE SC	2.25	0	0	3	1	15.64	3.65	25.87	45.16	4.98	805	211
272	ROCHESTER MN	2.25	0	0	3	1	15.60	3.64	25.81	45.05	4.99	656	195
273	WILMINGTON NC	2.25	0	0	3	1	15.50	3.62	25.65	44.77	5.03	1040	216
274	ROCK HILL SC	2.25	0	0	3	1	15.45	3.60	25.55	44.61	5.04	684	19[illegible]
275	ANNISTON AL	2.25	0	0	3	1	15.43	3.60	25.53	44.57	5.05	611	188

TABLE J-7

.995 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
276 TUSCALOOSA AL	2.25	0	0	3	1	15.37	3.59	25.43	44.40	5.07	1333	185
277 JACKSONVILLE NC	2.25	0	0	3	1	15.12	3.53	25.01	43.65	5.15	765	208
278 COLUMBIA MO	2.25	0	0	3	1	15.06	3.51	24.92	43.49	5.17	605	199
279 IOWA CITY IW	2.25	0	0	3	1	15.01	3.50	24.83	43.35	5.19	617	189
280 GADSDEN AL	2.25	0	0	3	1	14.91	3.48	24.66	43.04	5.23	555	178
281 MONROE LA	2.25	0	0	3	1	14.87	3.47	24.61	42.95	5.24	638	192
282 JOPLIN MO	2.25	0	0	3	1	14.78	3.45	24.45	42.67	5.27	1271	195
283 ALBANY GA	2.25	0	0	3	1	14.64	3.42	24.22	42.27	5.32	678	178
284 PORTSMOUTH-DOVER-ROC	2.25	0	0	3	1	13.69	3.19	22.64	39.52	5.69	496	166
285 * MICHIGAN	2.25	0	0	3	0	20.33	4.74	33.63	58.71	3.83	6	
286 * SOUTH CAROLINA	2.25	0	0	3	0	14.06	3.28	23.26	40.61	5.54	5	
287 SARASOTA FL	2.25	0	0	3	0	13.71	3.20	22.69	39.60	5.68	587	184
288 FARGO-MOORHEAD ND-MN	2.25	0	0	3	0	13.26	3.09	21.94	38.29	5.88	2794	146
289 LAWRENCE KS	2.25	0	0	3	0	13.20	3.08	21.83	38.10	5.90	471	160
290 ABILENE TX	2.25	0	0	3	0	13.00	3.03	21.50	37.53	6.00	2724	145
291 RENO NV	2.25	0	0	3	0	12.90	3.01	21.34	37.24	6.04	3500	140
292 VISALIA-TULARE-PORTE	2.25	0	0	3	0	12.74	2.97	21.08	36.79	6.12	3500	140
293 GALVESTON-TEXAS CITY	2.25	0	0	3	0	12.73	2.97	21.07	36.77	6.12	397	142
294 SALINAS-SEASIDE-MONT	2.25	0	0	3	0	12.08	2.82	19.98	34.87	6.45	3324	143
295 PUEBLO CO	2.25	0	0	3	0	11.78	2.75	19.48	34.00	6.62	2405	141
296 SAN ANGELO TX	2.25	0	0	3	0	11.28	2.63	18.65	32.56	6.91	1500	150
297 FORT COLLINS CO	2.25	0	0	3	0	11.25	2.62	18.61	32.48	6.93	2610	144
298 EUGENE-SPRINGFIELD O	2.25	0	0	3	0	11.23	2.62	18.57	32.42	6.94	3500	140
299 GRAND FORKS ND-MN	2.25	0	0	3	0	11.16	2.60	18.47	32.24	6.98	3451	141
300 GREELEY CO	2.25	0	0	3	0	10.94	2.55	18.09	31.58	7.12	3500	140
301 PROVO-OREM UT	2.25	0	0	3	0	10.93	2.55	18.08	31.56	7.13	2014	132
302 CHICO CA	2.25	0	0	3	0	10.47	2.44	17.32	30.23	7.44	1645	118
303 LAREDO TX	2.25	0	0	3	0	10.40	2.43	17.20	30.03	7.49	3306	143
304 BILLINGS MT	2.25	0	0	3	0	10.37	2.42	17.16	29.95	7.51	2642	145
305 VALLEJO-FAIRFIELD-NA	2.25	0	0	3	0	10.35	2.41	17.11	29.87	7.53	1611	117
306 BISMARK ND	2.25	0	0	3	0	10.29	2.40	17.03	29.72	7.57	3500	140
307 SALEM OR	2.25	0	0	3	0	10.10	2.36	16.71	29.16	7.72	1902	128
308 CASPER WY	2.25	0	0	3	0	10.02	2.34	16.58	28.94	7.77	3500	140
309 YUBA CITY CA	2.25	0	0	3	0	9.97	2.33	16.50	28.80	7.81	1776	124
310 * ARKANSAS	1.50	0	0	2	0	13.72	3.20	22.69	39.60	3.79	4	
311 * LOUISIANA	1.50	0	0	2	0	13.52	3.15	22.36	39.03	3.84	4	
312 * ARIZONA	1.50	0	0	2	0	9.51	2.22	15.74	27.48	5.46	3	
313 * UTAH	1.50	0	0	2	0	9.42	2.20	15.58	27.20	5.51	3	
314 * WASHINGTON	1.50	0	0	2	0	8.75	2.04	14.48	25.28	5.93	3	
315 * MONTANA	1.50	0	0	2	0	8.57	2.00	14.18	24.75	6.06	2	
316 DAYTONA BEACH FL	0.75	0	0	1	1	15.07	3.52	24.94	43.53	1.72	1062	215
317 MELBOURNE-TITUSVILLE	0.75	0	0	1	1	14.85	3.46	24.56	42.87	1.75	1011	216
318 LUBBOCK TX	0.75	0	0	1	1	14.77	3.45	24.43	42.65	1.76	893	216
319 WACO TX	0.75	0	0	1	1	14.67	3.42	24.27	42.36	1.77	1000	217
320 GAINESVILLE FL	0.75	0	0	1	1	14.51	3.39	24.00	41.89	1.79	916	216
321 TYLER TX	0.75	0	0	1	1	14.26	3.33	23.58	41.17	1.82	934	217
322 LONGVIEW TX	0.75	0	0	1	1	14.20	3.31	23.48	40.99	1.83	1175	207
323 ST JOSEPH MO	0.75	0	0	1	1	13.99	3.26	23.14	40.39	1.86	840	213
324 SIOUX CITY NE-IA	0.75	0	0	1	1	13.97	3.26	23.10	40.33	1.86	1126	211
325 LAKE CHARLES LA	0.75	0	0	1	1	13.96	3.26	23.10	40.32	1.86	1105	212
326 PINE BLUFF AR	0.75	0	0	1	1	13.74	3.21	22.73	39.68	1.89	873	215
327 SIOUX FALLS SD	0.75	0	0	1	1	13.70	3.20	22.66	39.56	1.90	813	212
328 LAWTON OK	0.75	0	0	1	1	13.36	3.12	22.10	38.58	1.94	1084	214
329 PASCAGOULA-MOSS POIN	0.75	0	0	1	1	13.24	3.09	21.91	38.24	1.96	736	205
330 FORT WALTON BEACH FL	0.75	0	0	1	1	13.23	3.09	21.89	38.21	1.96	944	217

TABLE J-7

.995 UNSHARED

	CAPTURED MBPS	LRG ES	MED ES	SML ES	MINI ES	VOICE MBPS	DATA MBPS	VIDEO MBPS	TOTAL MBPS	CAPTURED PCT	METRO SQ MI	CITY SQ MI
331 FORT MYERS FL	0.75	0	0	1	1	13.23	3.09	21.89	38.20	1.96	785	209
332 PANAMA CITY FL	0.75	0	0	1	1	12.92	3.02	21.38	37.32	2.01	747	206
333 ENID OK	0.75	0	0	1	1	12.33	2.88	20.41	35.62	2.11	1054	215
334 SHERMAN-DENISON TX	0.75	0	0	1	1	12.33	2.88	20.40	35.61	2.11	940	217
335 BRYAN-COLLEGE STATIO	0.75	0	0	1	0	12.68	2.96	20.97	36.61	2.05	585	183
336 BRADENTON FL	0.75	0	0	1	0	12.29	2.87	20.33	35.48	2.11	739	205
337 STOCKTON CA	0.75	0	0	1	0	11.98	2.80	19.82	34.60	2.17	1412	170
338 ODESSA TX	0.75	0	0	1	0	11.68	2.72	19.32	33.72	2.22	907	216
339 MIDLAND TX	0.75	0	0	1	0	11.58	2.70	19.16	33.44	2.24	939	217
340 BOISE CITY ID	0.75	0	0	1	0	11.31	2.64	18.71	32.65	2.30	1043	216
341 VICTORIA TX	0.75	0	0	1	0	11.21	2.61	18.54	32.36	2.32	872	216
342 BROWNSVILLE-HARLINGE	0.75	0	0	1	0	10.84	2.53	17.94	31.31	2.40	896	216
343 SANTA CRUZ CA	0.75	0	0	1	0	10.27	2.40	17.00	29.67	2.53	440	153
344 LAS CRUCES NM	0.75	0	0	1	0	9.83	2.29	16.26	28.38	2.64	3500	140
345 YAKIMA WA	0.75	0	0	1	0	9.72	2.27	16.08	28.07	2.67	3500	140
346 LEDDING CA	0.75	0	0	1	0	9.58	2.24	15.85	27.67	2.71	3500	140
347 RICHLAND-KENNEWICK W	0.75	0	0	1	0	9.37	2.19	15.50	27.06	2.77	2975	146
348 MEDFORD OR	0.75	0	0	1	0	9.28	2.16	15.35	26.79	2.80	2812	146
349 GREAT FALLS MT	0.75	0	0	1	0	9.18	2.14	15.18	26.50	2.83	2661	145
350 BREMERTON WA	0.75	0	0	1	0	8.52	1.99	14.10	24.61	3.05	393	141
351 BELLINGHAM WA	0.75	0	0	1	0	8.49	1.98	14.05	24.52	3.06	2126	135
352 * WEST VIRGINIA	0.00	0	0	0	0	20.82	4.86	34.44	60.11	0.00		
353 * RHODE ISLAND	0.00	0	0	0	0	18.90	4.41	31.26	54.57	0.00		
354 * DELAWARE	0.00	0	0	0	0	18.88	4.41	31.24	54.53	0.00	1	
355 * NEW HAMPSHIRE	0.00	0	0	0	0	15.03	3.51	24.86	43.40	0.00		
356 * VERMONT	0.00	0	0	0	0	14.56	3.40	24.09	42.04	0.00		
357 * MAINE	0.00	0	0	0	0	11.77	2.75	19.47	33.98	0.00		
358 * ORESON	0.00	0	0	0	0	11.35	2.65	18.78	32.77	0.00	4	
359 * COLORADO	0.00	0	0	0	0	11.06	2.58	18.30	31.94	0.00	4	
360 * NEW MEXICO	0.00	0	0	0	0	9.77	2.28	16.16	28.22	0.00	5	
361 * WYOMING	0.00	0	0	0	0	9.29	2.17	15.37	26.84	0.00	1	
362 * NEVADA	0.00	0	0	0	0	8.91	2.08	14.75	25.74	0.00	1	
363 * IDAHO	0.00	0	0	0	0	8.85	2.07	14.64	25.56	0.00	5	
364 OLYMPIA WA	0.00	0	0	0	0	8.22	1.92	13.60	23.74	0.00	714	202
	4701.61	0	439	4425	227	9014.19	2103.22	14912.59	26030.00	18.06		

ORIGINAL PAGE IS OF POOR QUALITY

APPENDIX K
INTRA-URBAN TOPOLOGY

K.1 INTRODUCTION

The purpose of this task was to describe three traffic nodes based on secondary and primary research (i.e., site visit) information so that the results of the nationwide traffic distribution model developed in Task 2.1 could be evaluated and fine-tuned. By using sub-nodal information to locate earth stations within an SMSA, the number, size and location of earth stations for the entire SMSA could be compared with that postulated by the nationwide traffic distribution model and appropriate modifications could be made in the model.

The following steps were conducted to accomplish this purpose:

a. The selection of three traffic nodes
b. Secondary research to describe each node
c. Site visits to each node to verify and add to secondary research information
d. Description of each node based on secondary and primary research findings.

K.2 SELECTION OF SITES

In selecting the three sites the intent was to select sites whose analyses would lead to the greatest amount of information on intra-urban topology. The selection criteria included such variables as: geography (i.e., North, South, East or West), size (number of square miles), number and variety of users (i.e., businesses, institutions, Government agencies) and growth trends (e.g., in population or new industries). While diversity was a top priority, only those SMSAs which were large enough to have a variety of users and to be potential CPS users were considered. The three selected sites were Boston, Denver and Seattle.

K.3 SECONDARY RESEARCH

Secondary research involved identifying, collecting, reviewing and summarizing a variety of sources of information on each of the three sites. Information was obtained from: the Dun and Bradstreet files on business (e.g., number of businesses and number of employees by zip code), local Governmental agencies (e.g., Industrial Park Guides and Directories of Manufacturers); Federal Government Reports (e.g., Distribution of Personnel by SMSA); and several key sources like Rand McNally used to determine location and size of universities. After reviewing this information, it was organized and represented on a map of the particular SMSA and was used to guide the site visits (see Figures K-1, 2 and 3).

K.4 SITE VISITS

A site visit was conducted for each of the three selected SMSAs to collect information from specific users of the various telecommunication services. For each site onsite interviews were conducted with the communications managers of a variety of businesses, institutions and Governmental agencies. Three to four days were spent interviewing 12 to 15 people at each site. In each case, current users of CPS type services were interviewed. Information obtained during these interviews focused on current and future traffic projections, plans concerning CPS type services, and reasons for expectations about future use of CPS type services. The intent was to obtain information from current or potential CPS users so that their plans could be used to determine where earth stations should be placed in the particular SMSA.

K.5 DESCRIPTION OF NODES

The secondary research and site-visit information were integrated for each of the three SMSAs and then used to determine the size and placement of earth stations by zip code (sub-node) area for each SMSA. The Market Distribution Model was used to determine the expected amount of CPS traffic in 2000 for each of the three sites. These traffic amounts and the secondary and site-visit research findings were used to project how many of each size of earth station will be operating in each zip code area of each site in the year 2000.

On the maps for the three sites, three symbols were used to determine the preparation of the earth stations, projected by the nationwide model, that should be allotted to each zip code area. The three symbols indicated: number of businesses, number of businesses with more than ten thousand employees, and the number of major institutions and government agencies. For number of businesses, one circle was given if the number of businesses was between 100 and 200; two were given if the number of businesses was greater than 200. For number of businesses with more than ten thousand employees, one circle was given if three to four businesses had more than this number of employees; two circles were given if five or more did. For number of major institutions, one circle was given if at least one major institution or government agency existed in the zip code area. The number of circles was then used to determine how many of each type of earth stations should be allotted to each zip code area.

K.6 DISCUSSION

The information on each node and sub-node is summarized in the following tables (i.e., Tables k-1 through K-6) and maps (i.e., Figures K-1, 2 and 3). The first table for each site (i.e., Tables K-1, 3 and 5) indicates the numbers of each type of earth station projected for the site. This table is followed by the map for the site. The second table for each site (i.e., Tables K-2, 4 and 6) indicates the number of each type of earth station for each sub-node (i.e., zip code). Also indicated as Table K-7 is the number of earth stations projected by the model for New York: This table was presented for the three sites could be compared with New York.

For Boston, the Nationwide Model projects all earth stations within a 12 mile radius as does the intra-urban topology. For Denver, the Nationwide Model projects all earth stations within a 12 mile radius as does the intra-urban topology. For Seattle, the Nationwide Model projects all earth stations within a 12 mile radius, while intra-urban topology projects 82%. The nationwide model projected that New York would have earth stations in its third ring.

BOSTON MA

TOTAL TRAFFIC: 306.94

TABLE K-1

CAPTURED TRAFFIC: 92.70

RING	LRG NODE	LRG TOT	MED NODE	MED TOT	SML NODE	SML TOT	MINI NODE	MINI TOT
1	0	0	3	3	23	23	0	0
2	0	0	0	0	11	88	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
		0		3		111		3

* RADII IN MILES, DOTTED LINE REPRESENTS CENTRAL CITY

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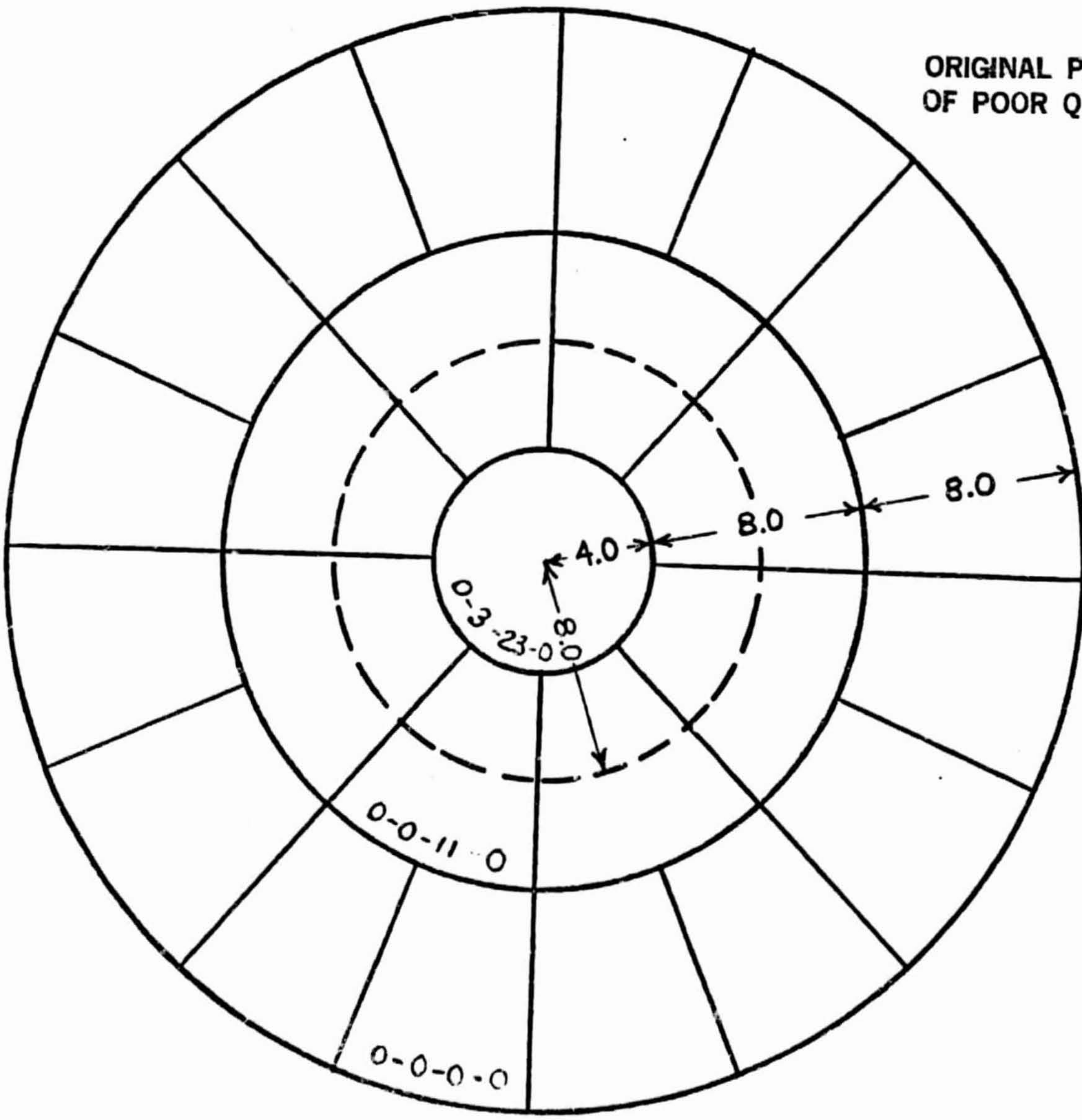
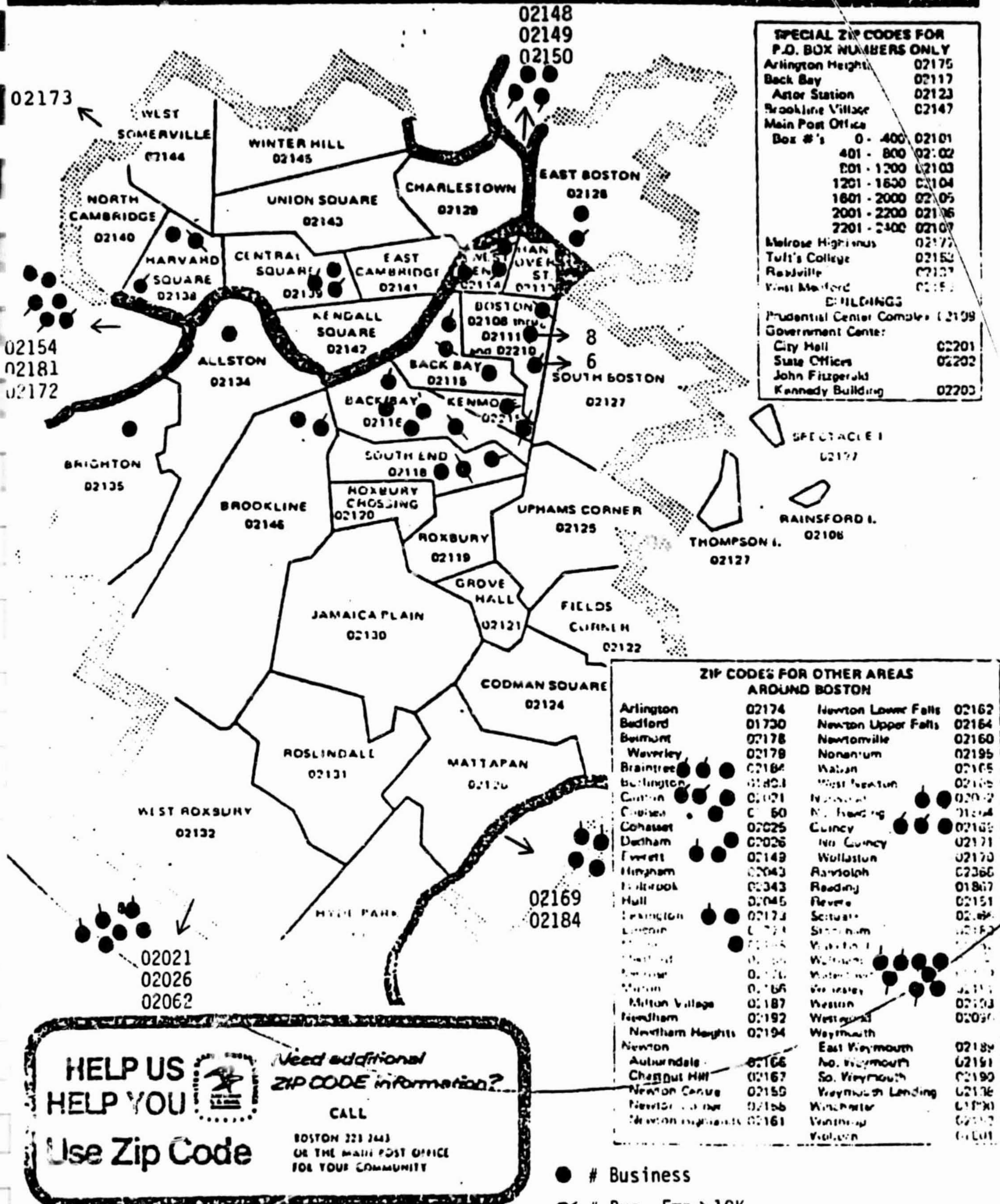


POSTAL ZIP CODES FOR BOSTON AREA



SPECIAL ZIP CODES FOR P.O. BOX NUMBERS ONLY

Arlington Heights		02175
Back Bay		02117
Astor Station		02123
Brookline Village		02147
Main Post Office		
Box #'s	0 - 400	02101
	401 - 800	02102
	801 - 1200	02103
	1201 - 1600	02104
	1601 - 2000	02105
	2001 - 2200	02106
	2201 - 2400	02107
Melrose Highlands		02177
Tuft's College		02153
Readville		02137
West Medford		[illegible]
BUILDINGS		
Prudential Center Complex		02199
Government Center:		
City Hall		02201
State Offices		02202
John Fitzgerald Kennedy Building		02203

ZIP CODES FOR OTHER AREAS AROUND BOSTON

Arlington	02174	Newton Lower Falls	02162
Bedford	01730	Newton Upper Falls	02164
Belmont	02178	Newtonville	02160
Waverley	02179	Nonantum	02195
Braintree	02184	Waban	02165
Burlington	01803	West Newton	[illegible]
Canton	02021	[illegible]	[illegible]
Chelsea	02150	No. Reading	01864
Cohasset	02025	Quincy	[illegible]
Dedham	02026	No. Quincy	02171
Everett	02149	Wollaston	02170
Hingham	02043	Randolph	02368
Holbrook	02343	Reading	01867
Hull	02045	Revere	02151
Lexington	02173	Scituate	[illegible]
Lincoln	[illegible]	Stoneham	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Milton	02186	Wellesley	[illegible]
Milton Village	02187	Weston	02193
Needham	02192	Westwood	02090
Needham Heights	02194	Weymouth	
Newton		East Weymouth	02189
Auburndale	02166	No. Weymouth	02191
Chestnut Hill	02167	So. Weymouth	02190
Newton Centre	02159	Weymouth Landing	02188
Newton [illegible]	02158	Winchester	01890
Newton Highlands	02161	Winthrop	[illegible]
		Woburn	01801

\# Business

\# Bus, Emp > 10K

\# Gov/Inst

IL4 264 384

FIGURE K-1

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TABLE K-2. BOSTON
INTRA URBAN TOPOLOGY

(Configuration: Shared/Unshared: Availability: .999)

Distribution of Earth Stations by Zip Code

Criteria:
1. Number of Businesses
2. Number of Businesses with more than 10,000 employees
3. Number of major Government agencies and institutions

ZIP CODE	EARTH STATION SIZE		
BOSTON			
02108 - 02111 + 02210	2	25	
02116	1	6	
02114		5	
02115		5	
02118		5	
02138		5	
02139		5	
02128		4	
02146		4	
02215		4	
02134		1	
02135		1	
AROUND BOSTON	**MEDIUM**	**SMALL**	**MINI**
02154		7	
02184		5	
02021		5	
02169		5	
02149		4	
02173		3	
02062		3	
02172		3	1
02181		3	1
02148		1	
02150		1	1
02026		1	1
	3	111	3

DENVER-BOULDER CO

TOTAL TRAFFIC: 172.58

CAPTURED TRAFFIC: 58.50

TABLE K-3

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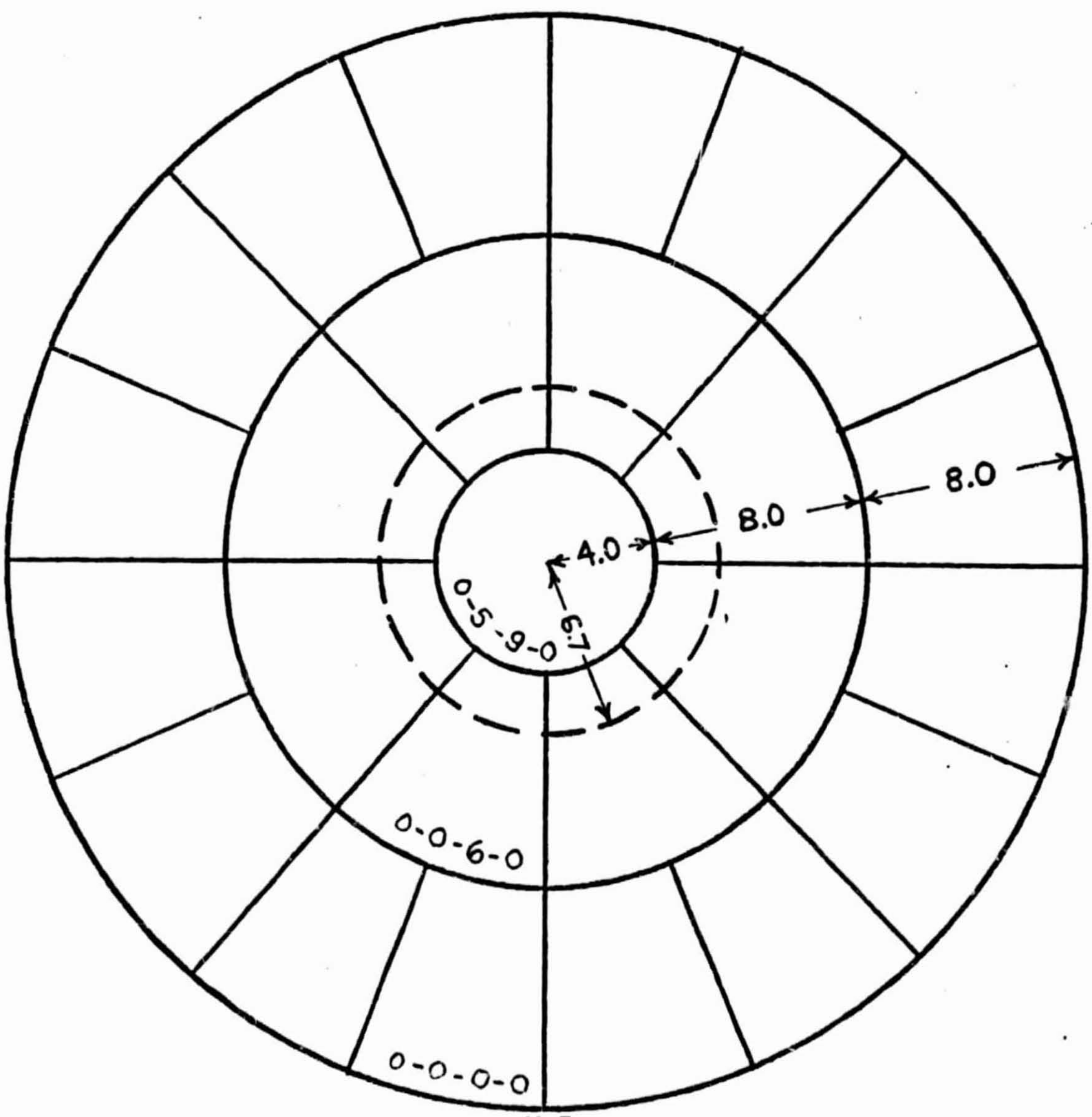
RING	LRG NODE	LRG TOT	MED NODE	MED TOT	SML NODE	SML TOT	MINI NODE	MINI TOT
1	0	0	5	5	9	9	0	0
2	0	0	0	0	6	48	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
		0		5		57		2

* RADII IN MILES. DOTTED LINE REPRESENTS CENTRAL CITY



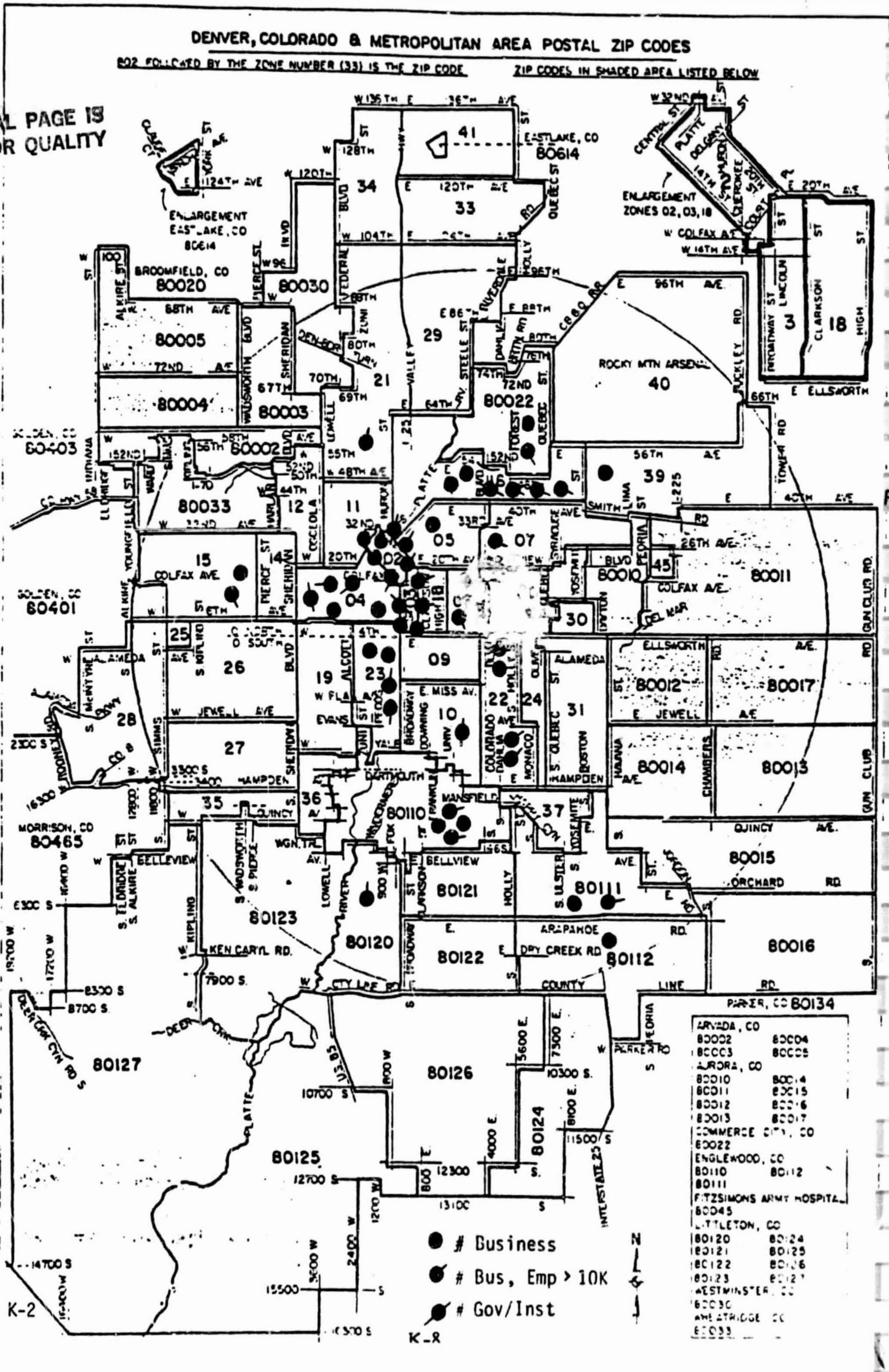

DENVER, COLORADO & METROPOLITAN AREA POSTAL ZIP CODES
802 FOLLOWED BY THE ZONE NUMBER (33) IS THE ZIP CODE
ZIP CODES IN SHADED AREA LISTED BELOW
ENLARGEMENT EASTLAKE, CO 80614
ENLARGEMENT ZONES 02, 03, 18
ROCKY MTN ARSENAL
ARVADA, CO
80002 80004
80003 80005
AURORA, CO
80010 80014
80011 80015
80012 80016
80013 80017
COMMERCE CITY, CO
80022
ENGLEWOOD, CO
80110 80112
80111
FITZSIMONS ARMY HOSPITAL
80045
LITTLETON, CO
80120 80124
80121 80125
80122 80126
80123 80127
WESTMINSTER, CO
80030
WHEATRIDGE, CO
80033
Business
Bus, Emp > 10K
Gov/Inst

FIGURE K-2

TABLE K-4. DENVER
INTRA URBAN TOPOLOGY

(Configuration: Shared/Unshared: Availability .999)

Distribution of Earth Stations by Zip Code:

Criteria:
1. Number of Businesses
2. Number of Busineeses with more than 10,000 employees
3. Number of major Government agencies and institutions

ZIP CODE	EARTH STATION SIZE		
	MEDIUM	SMALL	MINI
80202	1	9	
80203	1	6	
80216	1	6	
80204	1	4	
80222	1	3	
80223		7	
80110		7	
80206		2	
80215		2	
80022		2	
80111		2	
80112		1	1
80239		1	1
80205		1	
80207		1	
80120		1	
80221		1	
80210		1	
	5	57	2

SEATTLE-EVERETT WA TOTAL TRAFFIC: 108.04 TABLE K-5

CAPTURED TRAFFIC: 25.05

RING	LRG NODE	LRG TOT	MED NODE	MED TOT	SML NODE	SML TOT	MINI NODE	MINI TOT
1	0	0	2	2	9	9	0	0
2	0	0	0	0	2	16	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
		0		2		25		1

* RADII IN MILES, DOTTED LINE REPRESENTS CENTRAL CITY

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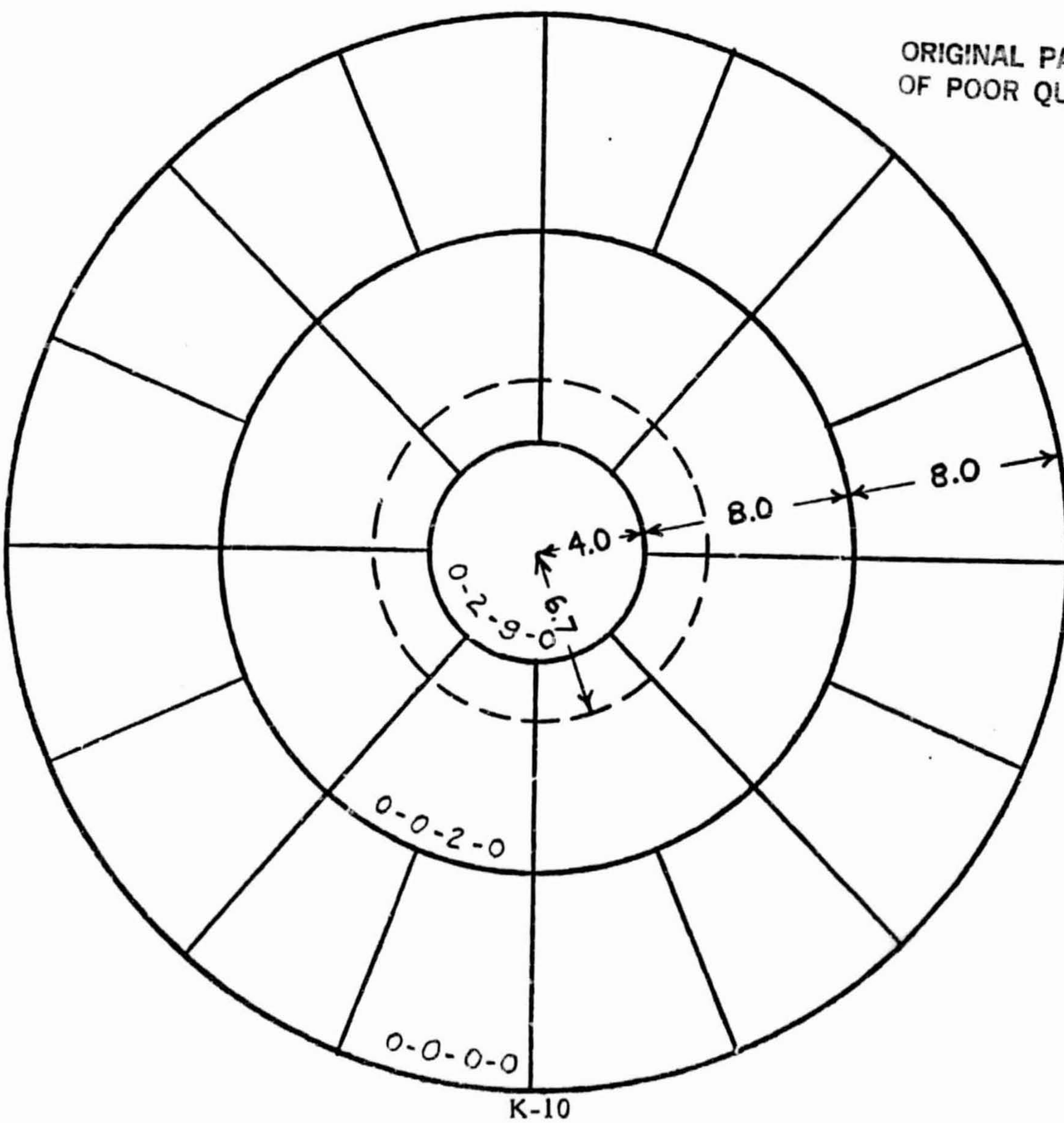

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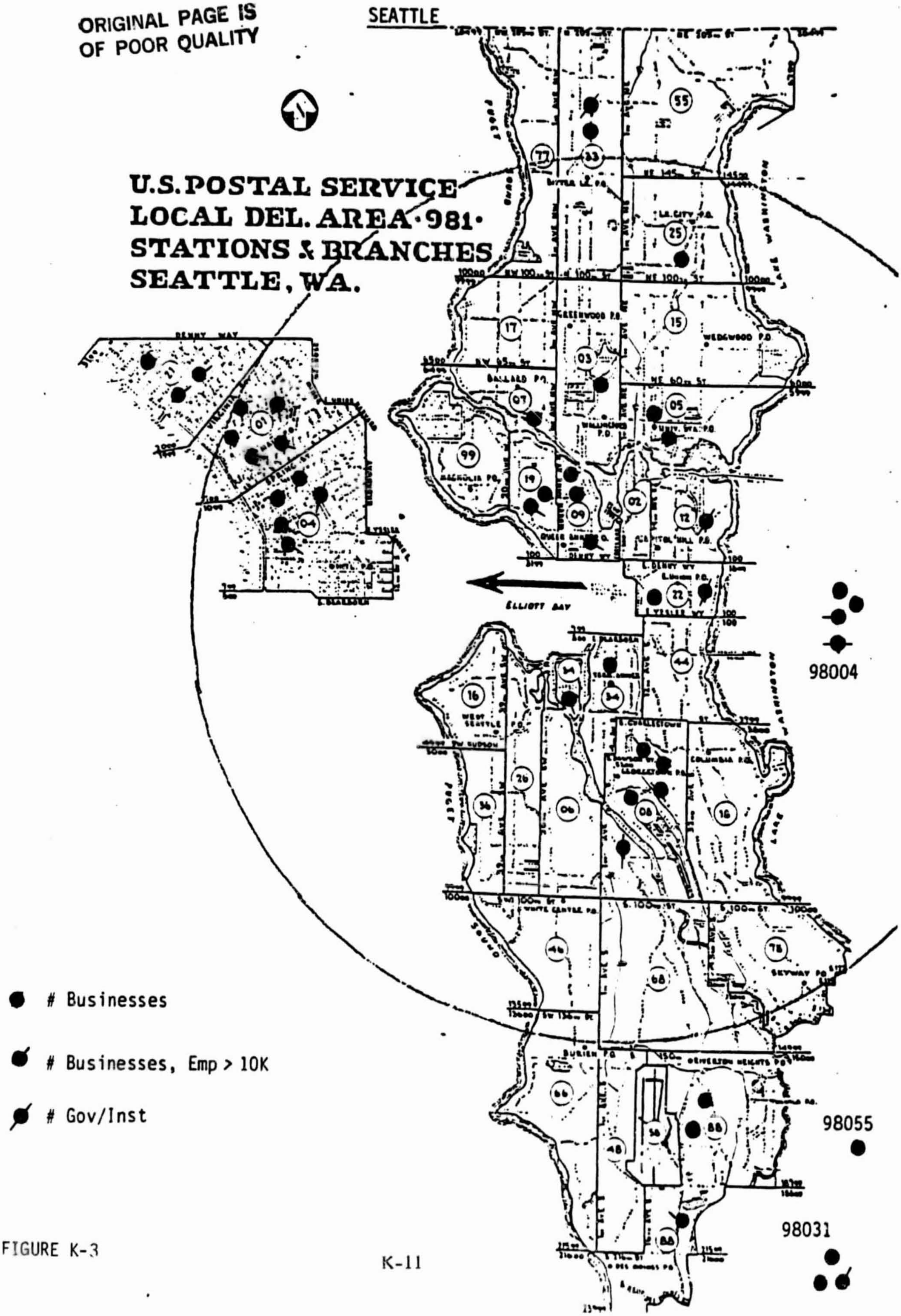

FIGURE K-3

TABLE K-6. SEATTLE
INTRA URBAN TOPOLOGY

(Configuration: Shared/Unshared: Availability: .999)

Distribution of Earth Stations by Zip Code:

Criteria: 1. Number of businesses.
2. Number of businesses with more than 10,000 employees
3. Number of major Government agencies and institutions

ZIP CODE	EARTH STATION SIZE		
	MEDIUM	SMALL	MINI
98101	1	0	
98104		4	
98108		4	
98004	1	0	
98031		2	
98188		2	
98109		2	1
98121		1	
98119		1	
98134		1	
98122		1	
98105		1	
98133		1	
98125		1	
98103		1	
98107		1	
98112		1	
98055		1	
	2	25	1

NEW YORK NY-NJ

TOTAL TRAFFIC: 1381.20

CAPTURED TRAFFIC: 692.60

TABLE K -7

	LRG		MED		SML		MINI	
RING	NODE	TOT	NODE	TOT	NODE	TOT	NODE	TOT
1	2	2	19	19	17	17	0	0
2	0	0	15	120	13	104	0	0
3	0	0	0	0	11	176	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
		2		139		297		4

* RADII IN MILES, DOTTED LINE REPRESENTS CENTRAL CITY

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